POPULAR SCIENCE MONTHLY

SEPT. 1947
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Sandhogs' Toughest Job

p. 82

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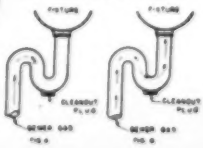

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Waterproofing Masonry Walls
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(Left) You SEE diagrams that help you locate and, with little effort, fix plumbing noises, leaks, and drain stoppages.

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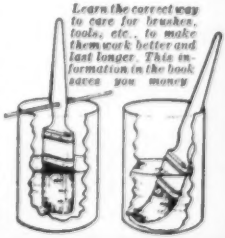

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(Left) Furniture upholstery and repair is a fascinating and money-saving hobby when you follow the easy step-by-step instructions in this book.

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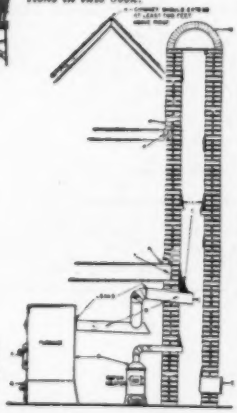
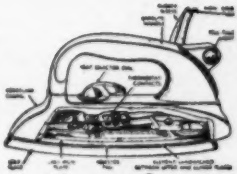


Is your chimney losing heat, wasting fuel? Make the checks suggested in this illustration (reduced in size) then follow the book's easy directions for repair.



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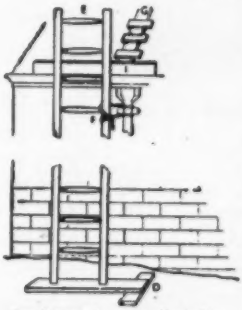

Avoid hazards. This illustration shows how to secure a ladder when you make roof repairs. The book is packed with ideas that save time and work and eliminate risks.

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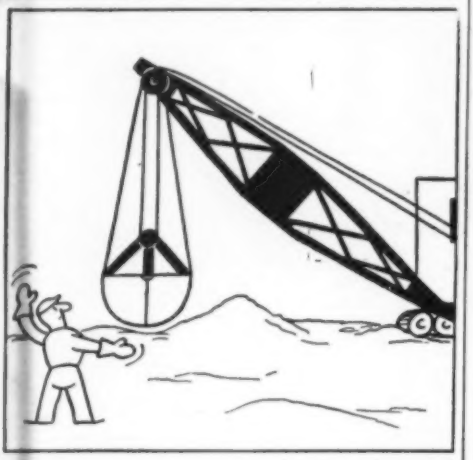

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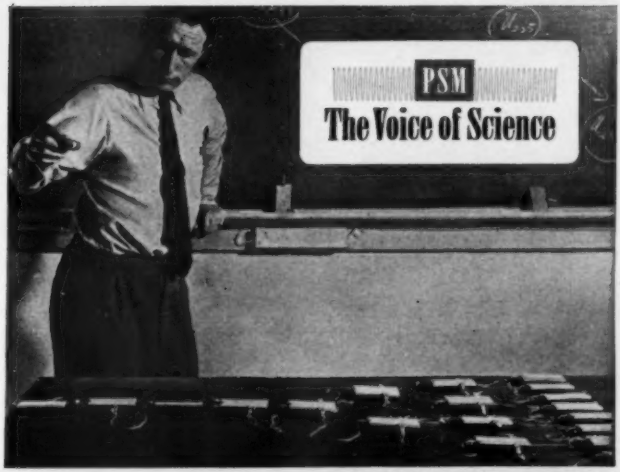
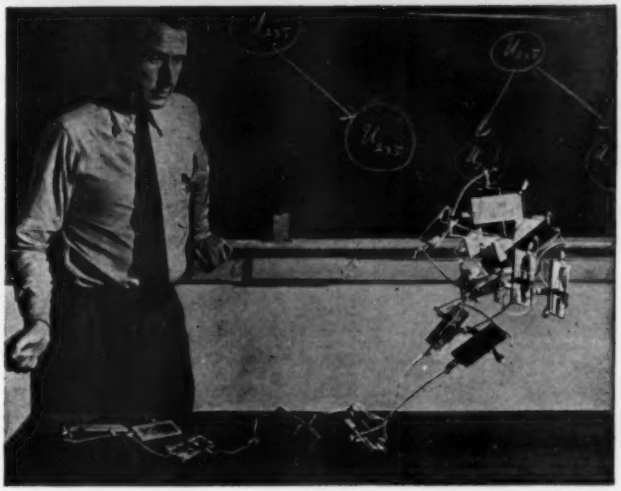


Ready, Set . . .

Here are the mousetraps on the table. Dr. Van der Grinten is about to drop a marble representing a neutron on the first "atom."



Go . . .

The "atoms" are "exploded" in an uncontrolled reaction. This is the theory behind the atomic bomb.

Mousetraps Catch Big Idea

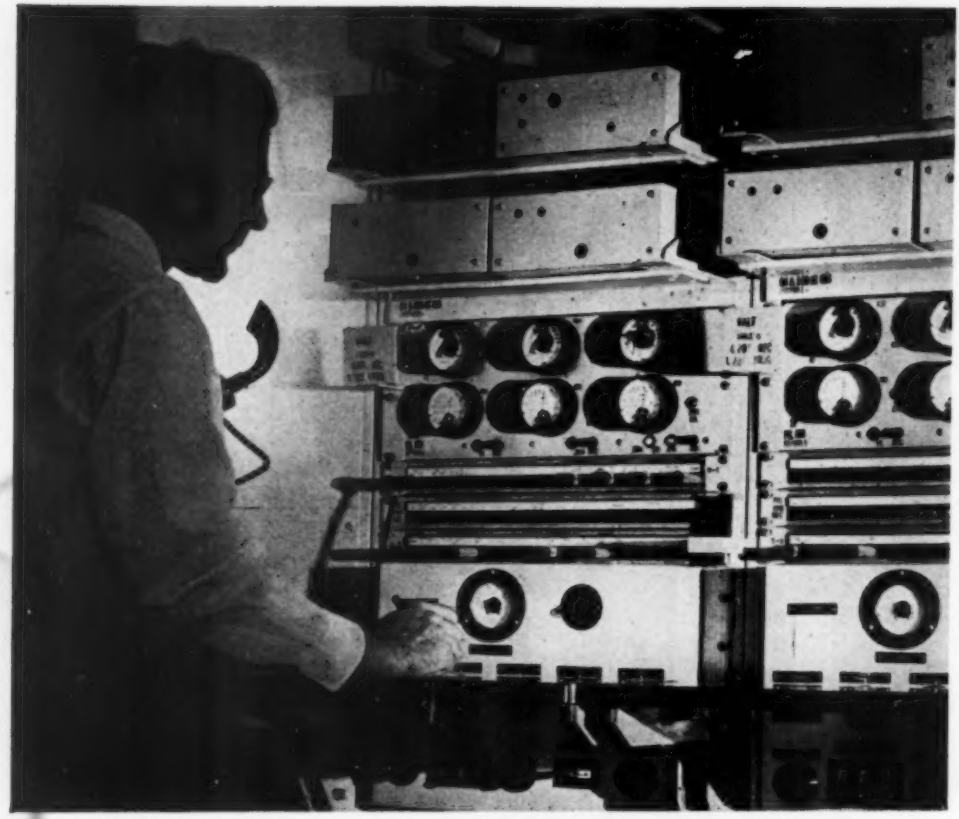
LAST month, on this page, an "Atomic Mousetrap" was cartooned as a desirable, if impossible, demonstration. But, I wrote, "while nuclear fission comes only in the big, all-family package . . . the *idea* can be put out in handy, one-brain doses."

This is exactly what three serious physicists with a sense of humor proceeded to do. It was a coincidence that they used mousetraps to illustrate the chain reaction. PSM was still on the press when Dr. Richard M. Sutton, of Haverford College, started playing with snappers. Meanwhile, in the General Electric Laboratories in Schenectady, Dr. William Van der Grinten and Dr. Lewi Tonks were rigging up their version of traps for ideas.

The contraptions are simple and cheap. Just rig up the traps with string, set them, touch them off, and watch the "reaction" race through the chain with a clatter as satisfying to school children as it is to Ph.Ds.

This month, when school opens, I hope every teacher who reads PSM will send out for mousetraps. This is the kind of teaching that makes learning easier.

Perry Gilkeson



At Philadelphia, a testboard man answers as an electronic watchman calls attention to conditions on one of the coaxial systems to Baltimore and Washington.

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Strung out along every Bell System coaxial cable, electronic watchmen constantly mount guard over your voice. Some are in manholes under city streets; some are in little huts on the desert. Most situations they can deal with; if things threaten to get out of hand, they signal the nearest testboard.

Principal care of the electronic watchman is the transmission level. Sun-warmed cables use up more energy than cold ones, so a transcontinental call may take a millionfold more energy to carry it by day than by night. Each watchman — an electronic regulator — checks the transmission level and adjusts the amplification which sends your voice along to the next point. Many hundreds of regulators may be at work on a single long distance call.

Without automatic regulation, the precise control of energy in the Bell System's long distance circuits would be a superhuman task. So Bell Telephone Laboratories, which in 1913 developed the first high-vacuum electronic amplifier, went on to devise the means to make them self-regulating in telephone systems. This is one reason why your long distance call goes through clearly, summer or winter.

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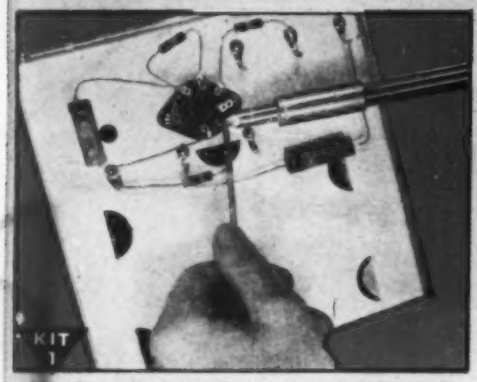
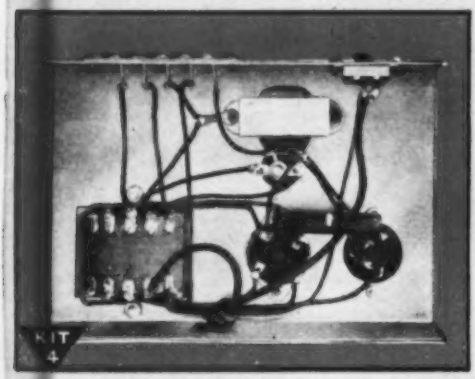
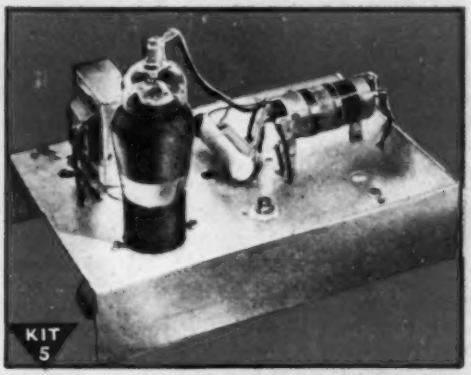


I send you Soldering Equipment and Radio parts; show you how to do Radio soldering; how to mount and connect Radio parts; give you practical experience.

Early in my course I show you how to build this N.R.I. Tester with parts I send. It soon helps you fix neighborhood Radios and earn EXTRA money in spare time.



You get parts to build this Vacuum Tube Power Pack; make changes which give you experience with packs of many kinds; learn to correct power pack troubles.



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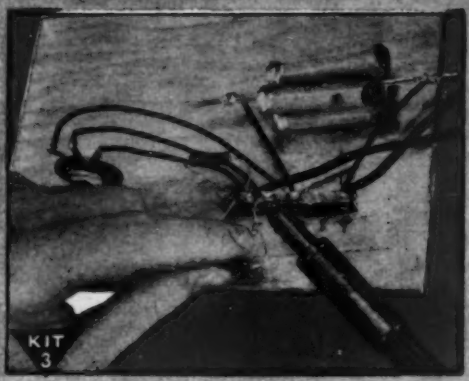

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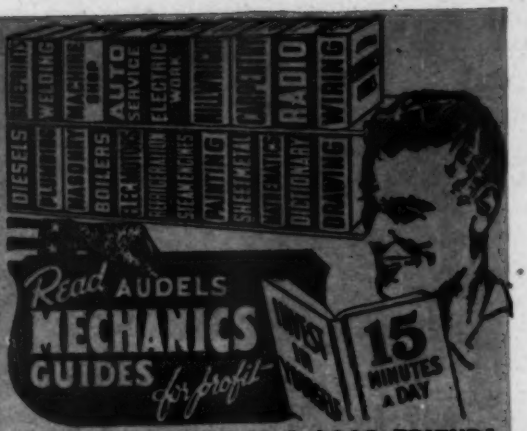

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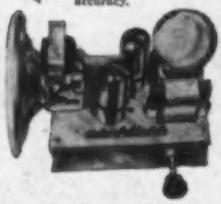

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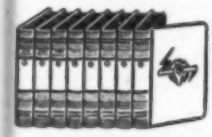

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Mixing Up Mosquitoes

Sir:

Your articles on harnessing streams (April through August) were quite thorough . . . but I think you omitted a very important phase: mosquito control. Particularly in the South, but elsewhere, too, this health menace should be considered.

If the pond has rather sharply sloping sides, with no grass in the water, minnows may solve the problem without help. But if the "eager beaver" is not so fortunate, he may still be able to avoid unsightly oil by using for a spillway two sets of drainage tiles, one set with the heads about five inches above the other.

By alternately covering and uncovering the lower set every four or five days during the mosquito season, he can destroy the larvae, either flooding them so that minnows can reach them, or leaving them high and dry. He should, however, make sure that there are no pools left around the edges at the low stage.

WILLIAM E. TOWNSEND

Memphis, Tenn.

Sound suggestions. PSM is happy to pass them along to supplement the articles, which were restricted by space to the mechanical problems involved.

Counting a Googol

Sir:

Is there such a word as "googol"? A friend tells me it's a mathematical term for infinity, but I think it's a gag. . . .

WALTON HERRIES

New York City

It's not a gag, but your friend is wrong. A googol, so named by a nine-year-old boy, is 1 followed by 100 zeros, written exponentially 10^{100}. *It is not infinity, but it's big. According to Kasner and Newman, authors of* Mathematics and the Imagination, *all the words ever printed total only about* 10^{16}

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(10 million billion). And Eddington has calculated all the electrons in the universe to be only 10^{79}. If you want a still bigger number, Dr. Kasner's little nephew gives you the googolplex, which is 1 followed by a googol of zeros, or $10^{10^{100}}$. If we devoted an entire issue of PSM, over a million copies, to nothing but printing this number (in small type), we still wouldn't get it all down. But even the googolplex is still finite.

Which End Is Which?

Sir:

I have long had a question in my mind about electromagnetic waves emitted from one end of a tube that is accelerating in the direction of the wave propagation and striking the other end.

Since the tube is accelerating while the waves are passing along the tube, won't the receiving end be traveling at a greater speed when a particular wave strikes it than the emitting end was when that wave left it? And therefore, won't the Doppler effect be observed at the receiving end, infinitesimal as it may be at low acceleration?

HARTLEY M. THOMPSON

West Hartford, Vt.

Mr. Thompson may go to the head of the class. His conclusions are entirely right.

Turn Off That Glass!

Sir:

A few days ago I met a man who claimed to have invented a new lighting system. Part of it I recognized as the old Geissler tube, forerunner of the neon-tube sign, but part of it has me stumped.

I was in a cafe when the fellow came in. He had a box about 18 by 10 by 6 inches, covered with black oilcloth. After the bartender plugged in the cord, the man laid a couple of Geissler tubes on the oilcloth. They glowed. Then he had the barkeep set several wine and whisky glasses on it, and they did likewise. . . .

When he touched them, they turned all colors of the rainbow. . . . When you ran a finger up and down the wineglass stems, you would have a rainbow on each side. . . . But if you lifted the glass up some inches, the stem would turn a very dark but bright blue.

Now I'm guessing he had some kind of high-frequency outfit in the box. Of course,

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the oilcloth may have had something to do with the color change. And I noticed that when he put the glasses on the corner of the box they failed to glow. Or maybe he had an ultraviolet light in the box covered with a specially treated oilcloth cover. . . .

V. E. HARPER

San Francisco, Calif.

As Mr. Harper suggests, a high-frequency outfit would explain the lighting of the Geissler tubes, but the rest leaves PSM wondering, too. The glasses may have contained special fluids that fluoresce under ultraviolet light. Or perhaps the demonstration was colored a little by its—hmm—environment.

A Wish Comes True

Sir:

In the June issue, in "I'd Like to See Them Make," a Mr. Cottingham, of Rowland, N. C., said he'd like to see a portable traffic light.

I am submitting for your inspection a photograph of a portable emergency traffic signal of which I am the inventor. . . .

This was first used in front of St. Gertrude's Church in Stockton from March 24 through April 1 to control the crowds gathering there for their annual Novena. . . .

During the time the signal was in use, we had no accidents whatever. Even on the first night in operation, there was no confusion, although it was the first time a machine of this type had been seen in this town.

SCOTT STETSON

Stockton, Calif.

Shown above in operation, Inventor Stetson's portable light has two small wheels at its base on which it is rolled like a dolly.

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Try This on For Size

Sir:

I found the article "Mapping the Milky Way" in the July issue both interesting and informative, as are most features . . . .

However, I believe that a mistake was made in the number given for the length of a cubic light-year's side. It was stated that the side was 3,900 billion miles long, while it should have been 5,880 billion miles, the distance that light travels in one year.

PAUL MUTSCHLECNER

Fort Wayne, Ind.

Abashed at the sheer size of the mistake, PSM is boning up on its arithmetic; 5,880 billion miles is the correct approximation.

For Pig's Sake!

Sir:

. . . Page 208 of the July issue carried an illustration and story entitled "Modern Pigpen of Steel." The picture shown was taken on our experimental farm at Paris, Ky., and shows an experimental hog house that was developed by our Product Development Division. . . . We are, therefore, very much interested to read that this hog house is made by the E. A. Strout Realty Agency, according to your magazine. . . .

EARL D. ANDERSEN

Republic Steel Corporation
Cleveland, O.

PSM naturally regrets the error, but disclaims responsibility. It was the result of completely misleading publicity material that accompanied the photo.

Don't Bank on It

Sir:

. . . In your explanation of the cutaway of the Pratt & Whitney Wasp Major aircraft engine (July, p. 112), you refer to it as having seven banks of four cylinders. Don't you mean four banks of seven cylinders each?

SGT. J. F. H.

Bolling Field, D. C.

Pratt & Whitney engineers insist that the engine has seven banks of four cylinders each, and since they made it, they ought to know. Remember, the cylinders are arranged helically around the engine, not radially. That's the difference.

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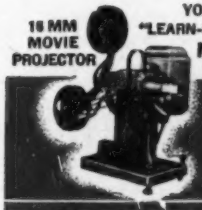

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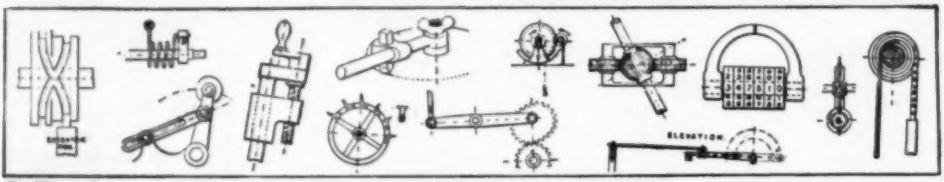

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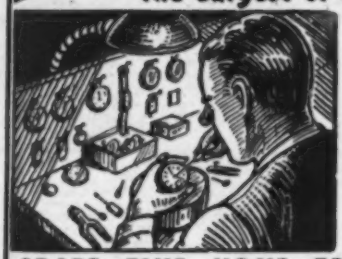

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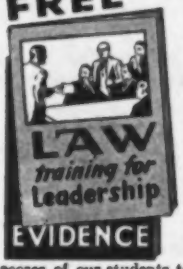

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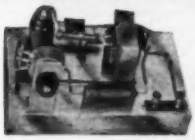

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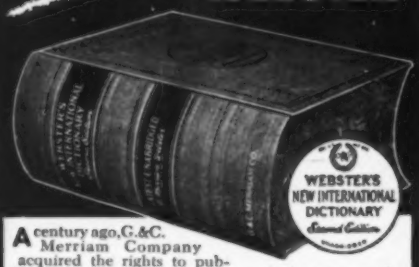

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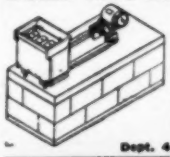

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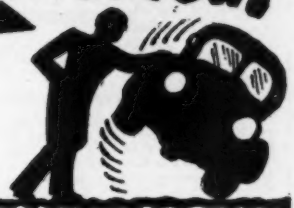

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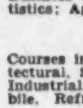

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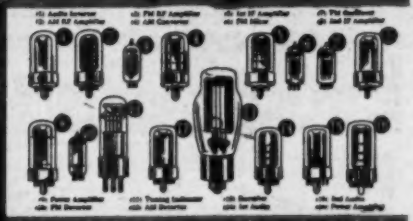

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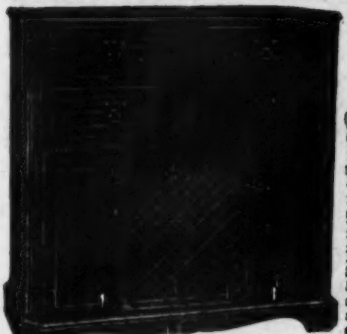

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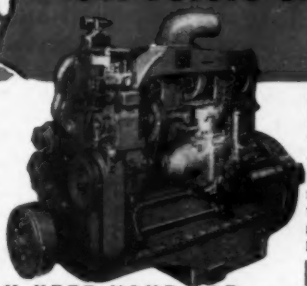

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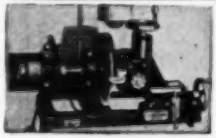

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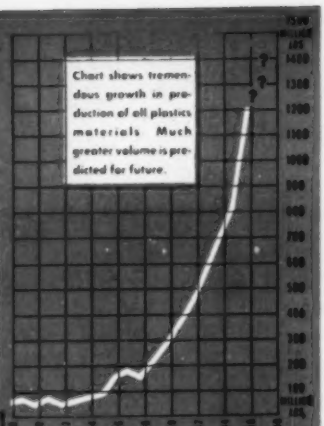

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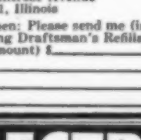

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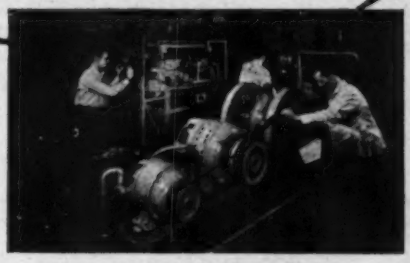

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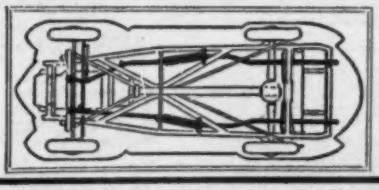

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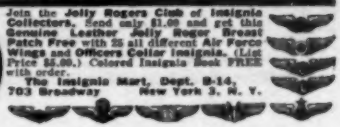

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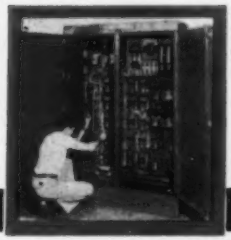

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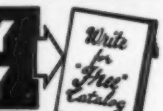

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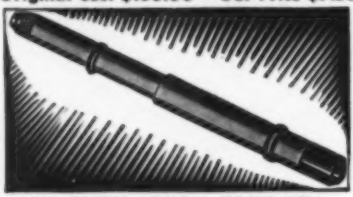

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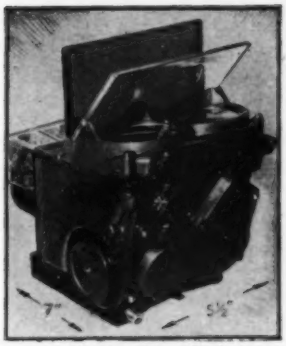

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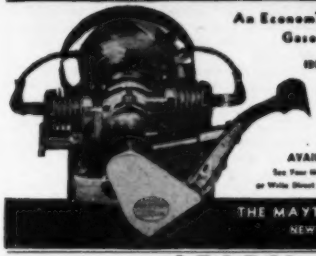

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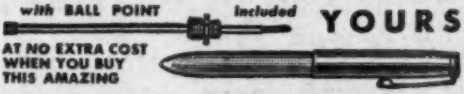

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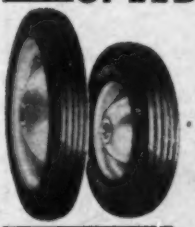

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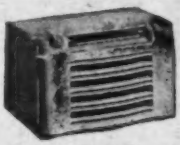

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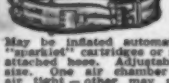

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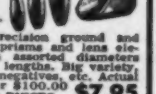

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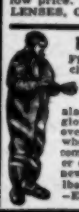

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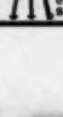

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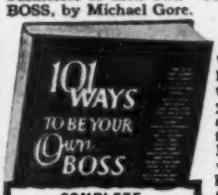

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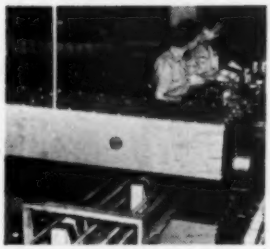

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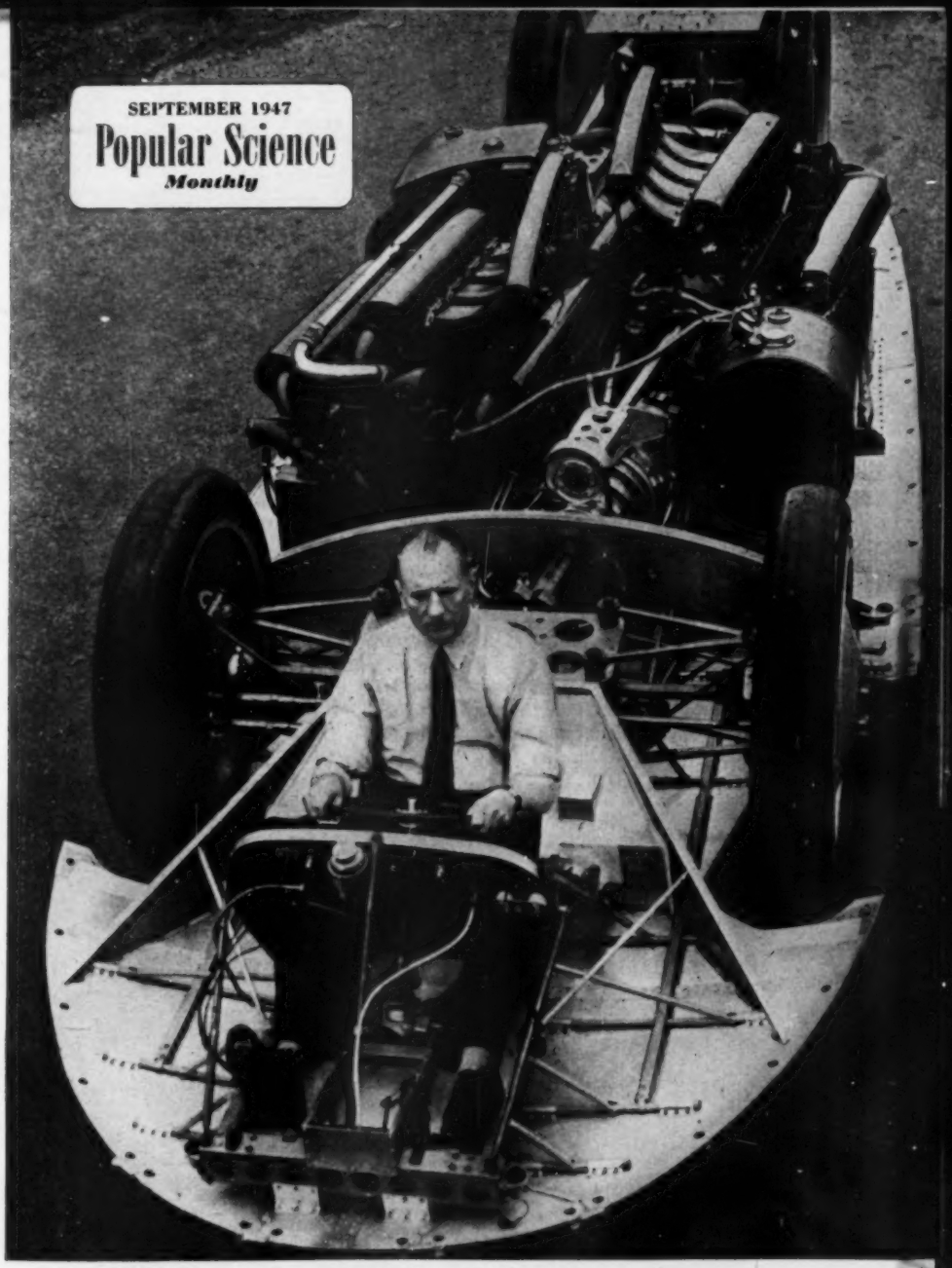
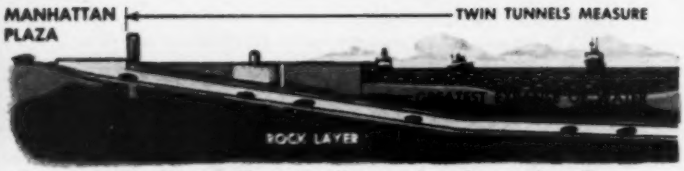


The Champ Gets Set . . . This impressive collection of machinery is the world's fastest automobile, with the titleholder, John Cobb, at the wheel. Back in August 1939, Cobb drove the Railton Special at 369.7 m.p.h., a new world's land speed record, on Bonneville Salt Flats, Utah. Now he's bringing it back again, expecting to go even faster. Here, the streamlined shell of the Railton Special has been removed to show its two Napier 12-cylinder, 1,250-hp. engines. The big car is 28 feet 8 inches long and 8 feet wide.



The Brooklyn-Battery Tunnel will carry four lanes of traffic

Sandhogs'

PSM's reporter and cameramen take you beneath a harbor for a preview of the new Brooklyn-Battery Tunnel.

By Alden P. Armagnac

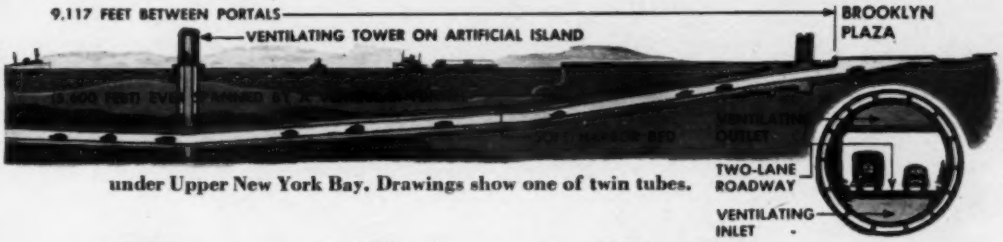
PSM photos by W. W. Morris, Hubert Luckett, and Robert F. Smith.

SANDHOGS won the toughest battle of many a veteran's career when the shields driving the twin tubes of the Brooklyn-Battery Tunnel beneath New York Harbor slid to a stop in the safety of solid rock. The half-mile stretch through the treacherous bottom of Buttermilk Channel was passed recently, and solid walls of cast-iron rings shut out forever the tons of water that a single false move, before then, would have loosed upon the tunnelers.

Ahead, only a few hundred feet of mica-flecked stone separated them from 4,000-foot rock tunnels, already driven to meet them from the Manhattan side. By the time you read this, the greatest and costliest of all vehicular tunnels may be holed through.

Figures prove the audacity of the $76,000,000 project. From portal to portal, the Brooklyn-Battery Tunnel measures 9,117 feet. It is 654 feet longer than the Holland

Concrete bulkhead with air locks is being demolished after having served its purpose.



under Upper New York Bay. Drawings show one of twin tubes.

Toughest Job

vehicular tube, the world's longest when it was opened. England's combination highway-and-tramway Mersey River tunnel stretches 10,584 feet between Liverpool and Birkenhead, but even this great single-tube tunnel will be surpassed by the new one as a motor route. The size of the ventilating plants that remove exhaust fumes is the tip-off, since it depends upon the cubic volume of space earmarked for motorists. And the ventilating system of the Brooklyn-Battery tubes, delivering 4,200,000 cubic feet or 160 *tons* of fresh air every minute, has no rival on earth.

Manhattan and Brooklyn are separated by 5,600 feet of green water, the widest body traversed by any vehicular tunnel in the world. The Holland Tunnel spans 5,480 feet of open water; the Mersey, less than 4,000. And the Mersey shaft, driven all the way through red sandstone, never needed compressed air to keep the river out. In contrast, sandhogs "locked in" and "locked out" of compressed air more than 1,000,000 times to build the new tunnel.

They forced their shields through mud, sand, gravel, boulders, peat, and ledge. When they're done they'll have excavated enough earth and rock, some 540,000 cubic yards, to fill up lower Broadway's famed

A tunnel locomotive brings up the dynamite car for a blast, in cross-drift between tubes.

Drill holes are loaded and men atop the Jumbo check electric wires that will fire the blast.

Electric delay caps touch off the dynamite after predetermined number of seconds indicated by numerals on their varicolored tags.

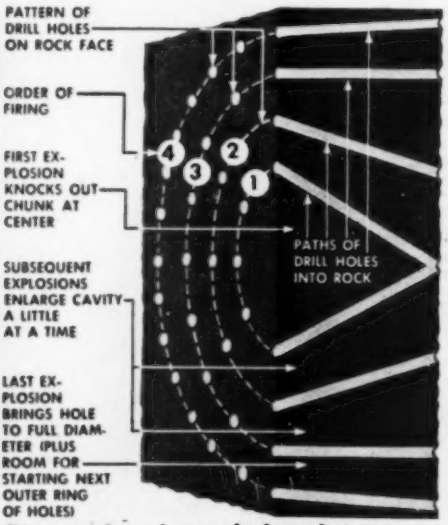


Diagram shows how multiple explosion carves a hole with simple circular outline. More elaborate patterns produce variety of shapes.

canyon to the fourth-story windows from Bowling Green to City Hall.

Scheduled to open in 1949, the tunnel's four traffic lanes will carry up to 16,000,000 cars yearly. Anyone who pays two bits at a toll booth may have a look at its slick bathroom-tiled interior and its fancy fluorescent lighting then. Now, however, only a privileged few can go behind the scenes where the newest wonder of the world is in the making.

Bring Your Rubbers

Come along with Popular Science's reporter and cameramen and see it. Wear your oldest clothes and, rain or shine, bring rubbers along. We'll meet at one of the field construction offices of the Triborough Bridge and Tunnel Authority—designers and builders of the tunnel—just outside the Brooklyn construction shaft of the east tube. There you can choose a sandhog helmet that fits you. That hard crown and shock-absorbing lining may save you a nasty jolt.

Two flights down rough wooden stairs and you're where the tunnelers started. You face the opening of one of the great 31-foot tunnels. Those massive iron rings, lining the tunnel as far as you can see, end peril of floods and cave-ins.

It's nearly three-quarters of a mile to the heading, where things are happening. Let's hop a ride on the back of a tunnel locomotive. Forget about keeping clean and lie flat—we go through tight places. Hang on, now, for a rough ride.

River Seeps Through

Duck your head! The doorway in the bottom of that concrete bulkhead nearly took our helmets off. The walls are bare rock now, and the tunnel is smaller. Our ride comes to an end in the pilot tunnel, through solid rock, under the mouth of the East River. Buttermilk Channel, overhead, seeps through the roof, runs down our necks, and spatters our faces with brine.

That noise like a million pavements being torn up comes from the Jumbo up ahead, the big drilling carriage on rails that reaches nearly to the tunnel ceiling. Seven high-speed drills at its forward end are going full blast. Using high-pressure air—80 pounds to the square inch—they penetrate nine feet of rock in 12 minutes.

Our locomotive is back again with a red car labeled "EXPLOSIVES" in white letters and reflector buttons. Floodlights blaze on

Scaler pries down loose rocks after a blast. His job looks deceptively unexciting, but tunnel men consider it the riskiest of all.

Mucking machine attacks the pile of rock thrown down by the blast. PSM's cover gives another view of the machine in action.

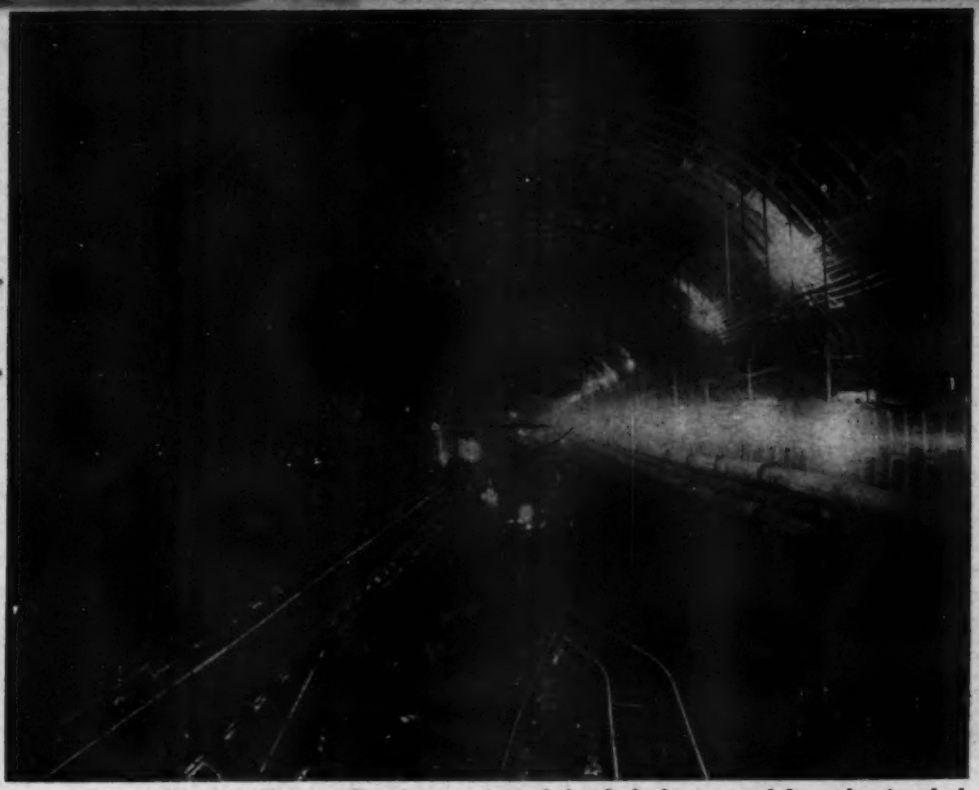
Shunting maneuvers with California switch prevent runaways on downgrade to the heading.

End of compressed-air operations permits installation, above, of pipes bringing fresh air to workers. (Smokers can now light up.)

men loading drill holes with 736 sticks of dynamite. Colored tags on the wires going into the holes bear labels like "Delay-4" and "Delay-6." Those are the number of seconds that will elapse, after the firing switch is closed, before each pencil-shaped blasting cap touches off the charge. There'll be a rapid-fire series of explosions, each one making room for rock to be knocked out by the next. If the rock has no place to go, the dynamite would simply blow the tamping out of the drill holes.

Like the blasting crew, we retreat 500 feet and flatten ourselves against the iron rings. A shock wave of air almost knocks us down. Then come the crashes of a heavy-artillery barrage. When we return to the heading, a husky "scaler" with a long crowbar is already prying down a chunk of roof loosened by the blast. He has to guess right about where the rock will fall, or else!

Below the ledge where he stands, a "mechanical mucker" (see cover) goes into action. Running on rails, it backs up, then lunges forward at the pile of blast-loosened rock, scooping it up in a bucket. Then the rising scoop wriggles from side to side, shak-



Iron rings consolidate sandhogs' possession of the shaft they wrested from the river bed.

ing its contents rearward onto a conveyer belt that deposits the rock in a rail car. Dancing on foot pedals and manipulating hand levers, the operator of the machine makes it seem almost alive.

The men roll back the rock-filled car and shunt it sideways off the main track, on a "California switch," to let a locomotive get past and push it out. A car coming uncoupled and running wild, downgrade to the tunnel heading, might plow into the workers crowded there. There are derailers to avert this, but the locomotive comes in ahead of cars and goes out behind them as an added safeguard.

Now for a closer look at the sights as we start walking back toward the entrance. About 200 feet from the heading, the rings end and the rock tunnel begins. Cars run through the lowest and largest opening in a great drum-shaped object of steel that fills up the whole tunnel. This is the shield, the underground bulldozer that led the sandhogs' drive through the rough going. A circle of 200-ton hydraulic jacks shoved it forward, 32 inches at a time. Each shove left room for an erector arm at its rear to

Sealing ring joints with waterproof calking of solid lead marks end of victorious battle to keep out the tons of water overhead.

Cutting edge of 350-ton tunneling shield stopped here in solid rock after its perilous journey through the ooze of New York's harbor.

assemble a new ring, from 14 segments and a key section. (Those bolts fastening the rings together are no watch charms—they weigh 10 pounds apiece.)

A shield driver's idea of paradise is the kind of soft Hudson River silt that the builders of the Holland and Lincoln Tunnels struck. You can close all but one or two openings in the shield, shove it "blind"—simply by main force—and the river bed comes out at the back like toothpaste from a tube. You advance just as fast as you can erect iron behind the shield; 19 rings in 24 hours was the Lincoln Tunnel record.

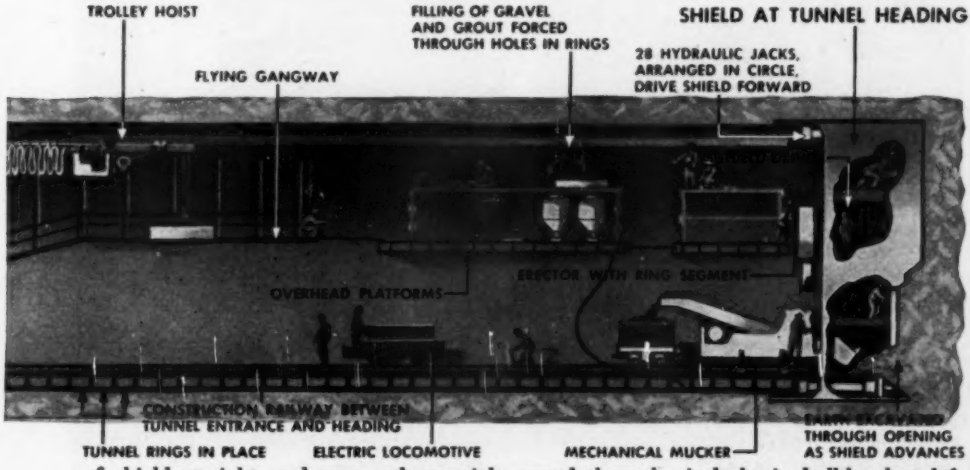
But the East River bottom, encountered by the Queens Midtown and Brooklyn-Battery tubes, is the tunnelman's purgatory. Men had to get out in front of the shield and dig, chip and blast out the mixture of soft stuff with boulders and sloping rock before it could move an inch. Actual "shoving" takes only 5 to 15 minutes, but one or two rings a day was good progress for this tunnel when the going was tough.

A few steps more bring us to a solid wall of concrete across the tunnel, with iron cylinders protruding through the 10-foot thickness of the bulkhead. That little one at the top is the emergency lock; the one on the side, the man lock; the bottom one, which we rode in through, is the "muck lock" for cars. Men and materials passed through these locks while compressed air held the river out.

Man locks of this tunnel had new helium-oxygen inhalation kits for sandhogs having trouble going under pressure. No matter how much a man waggles his jaws and

Compressed air held river out while sandhogs drove shaft through soft harbor bed with aid

Man lock in concrete bulkhead admitted sandhogs to section of tunnel under compressed air.



of shield at right, and men and materials passed through air locks in bulkhead at left.

swallows, there's sometimes a stoppage in his ears and severe pain from the rising pressure in the lock. If he grins and bears it, rather than face the others' jibes, he risks permanently injured eardrums. Otherwise, the lock tender must decompress a gang of 50, "lock out" the sufferer, and start over.

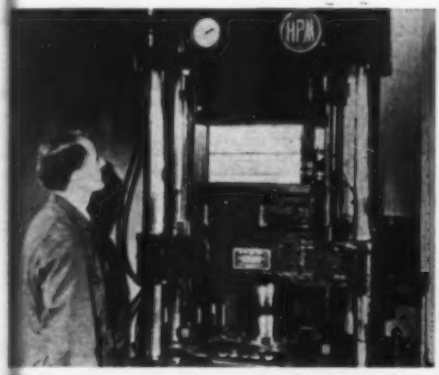
Now, at the first sign of trouble in the man lock, the sandhog takes out a black rubber mask, resembling a football noseguard. A few whiffs of a mixture of helium and oxygen gas, from a cylinder attached to the kit, and he is OK again. The thinness of the gas, compared to ordinary air, enables it to penetrate his air passages and relieve the stoppage. The outfit was specified for the first time as standard equipment by the Brooklyn-Battery contracts.

"Bends" remain to be licked. Within a couple of hours after leaving the tunnel, one man out of every 700 was likely to be overtaken by this painful, sometimes temporarily paralyzing illness. So that he wouldn't be mistaken for a drunk if he passed out cold, every sandhog wore a metal badge pinned to his shirt. It read: "Compressed Air Worker. If ill rush by ambulance to hospital lock located at 98 Hamilton Ave., Brooklyn, N. Y."

Digging a tunnel under 38 pounds' pressure, the maximum used here, was so strenuous that two shifts of an hour and a half apiece, with a 4½-hour rest period between, constituted a good day's work. If a cave-in flooded the heading, the men would dash for the safety of an overhead gangway, behind a solid steel "safety screen" extending halfway down the tunnel's diameter. An enormous bubble of air trapped between the safety screen and the concrete bulkhead would keep water from reaching them, while they escaped through an emergency lock; the bulkhead would wall off the river from the rest of the tunnel. This never happened on this job, but 20 men drowned for lack of such a precaution when the first Hudson River rail tunnel was built.

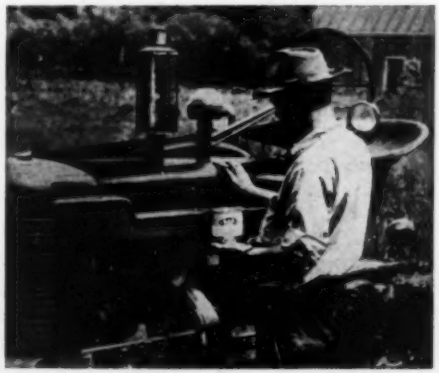
Now that the concrete bulkheads have served their purpose, they'll be blasted away to clear the tunnel. This next one we're coming to is already partly demolished. Only traces show where a third has been.

Back at the entrance and up the stairway, we step from the cool, dank atmosphere of the tunnel into the hot sunshine. We look like scarecrows, but we've seen the toughest tunneling job in the world on the eve of its completion. END



Plywood by the Foot

In a laboratory demonstration of the efficiency of high-frequency radio waves for dielectric heating, Westinghouse engineers have constructed plywood more than a foot thick. The experimental chunk was made up of 148 layers of birch veneer, and it proved to have a tensile strength equal to that of aluminum—15,000 p.s.i.—although it weighed only half as much.



Paint Needs No Brush

Wiped on with an applicator pad, a new paint for cars, farm equipment and other metal objects is said to give a glossy, professional-looking finish with a minimum of trouble. It is called Dab, for obvious reasons, and its lasting qualities as an automobile finish are guaranteed for a period of two years. It is being distributed by the Nu-Way Paint and Supply Co.

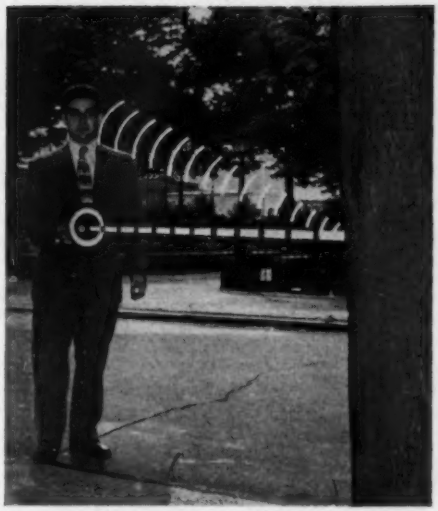
'Echo Flashlight' Helps the Blind Find Their Way

A "SOUND FLASHLIGHT" that enables the blind to use their ears for eyes has been developed at New York's City College. Smallest, lightest and least expensive device of its type yet developed, the apparatus has the effect of hanging a warning noise on any obstacle in a blind person's path.

It is the size and shape of an ordinary flashlight, but instead of a beam of light it projects a narrow beam of sound that is barely audible to the user when nothing lies ahead. Any obstacle, however, such as a lamppost, tree or fence, reflects the directed beam and changes its low, steady whine to a louder warning screech.

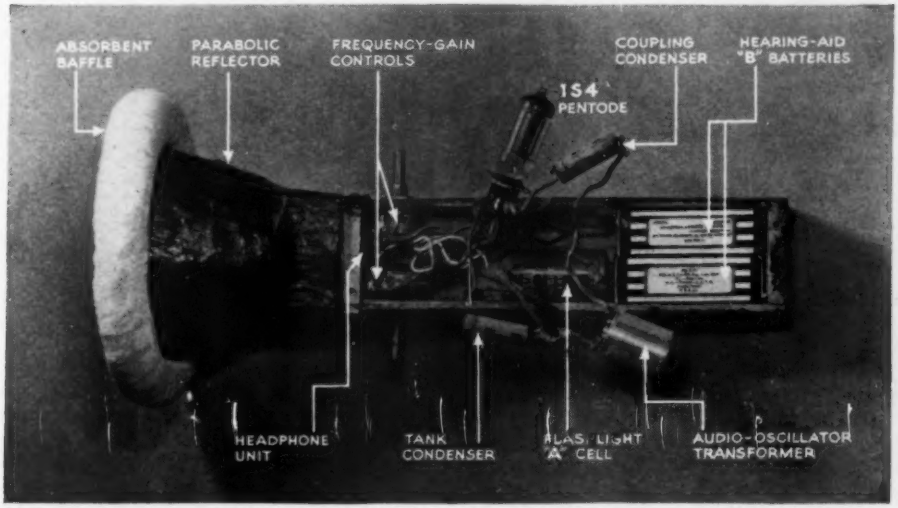
The device has three principal parts: an audio oscillator; a small headphone unit, or transducer, that converts the electrical oscillations to sound; and a parabolic reflector. An absorbent baffle is mounted around the rim of the reflector to prevent the sound from traveling directly to the user's ears.

The sound flashlight was developed by three City College undergraduates—two biology students and a former Army photographer who is studying physics—with the help of a faculty member. They planned the device as a scientific refinement of cane-tapping and finger-snapping—one that would aid blind persons in training their sense of hearing to build up acoustical images in compensation for their loss of sight.



Projected beam of "sound flashlight" is shaped by the reflector, but when it bounces off tree it is audible to the user and anyone else near by.

The original model cost $75, but commercial versions probably can be produced for much less. Also, while the working models are eight inches or more in length, manufacturing techniques may produce an apparatus that will fit in the head of a cane.



Cutaway of working model shows simplicity of construction; all parts normally fit inside case.

Lightning Strikes Thrice. This birdcage is a man-made thundercloud that can blast the Northrop F-15 with three bolts of lightning, but the bubble canopy will not shatter. A protective strip on the canopy carries away the 200,000 amps the generator produces for 1/10,000 second. Test was at Lightning and Transients Research Institute.

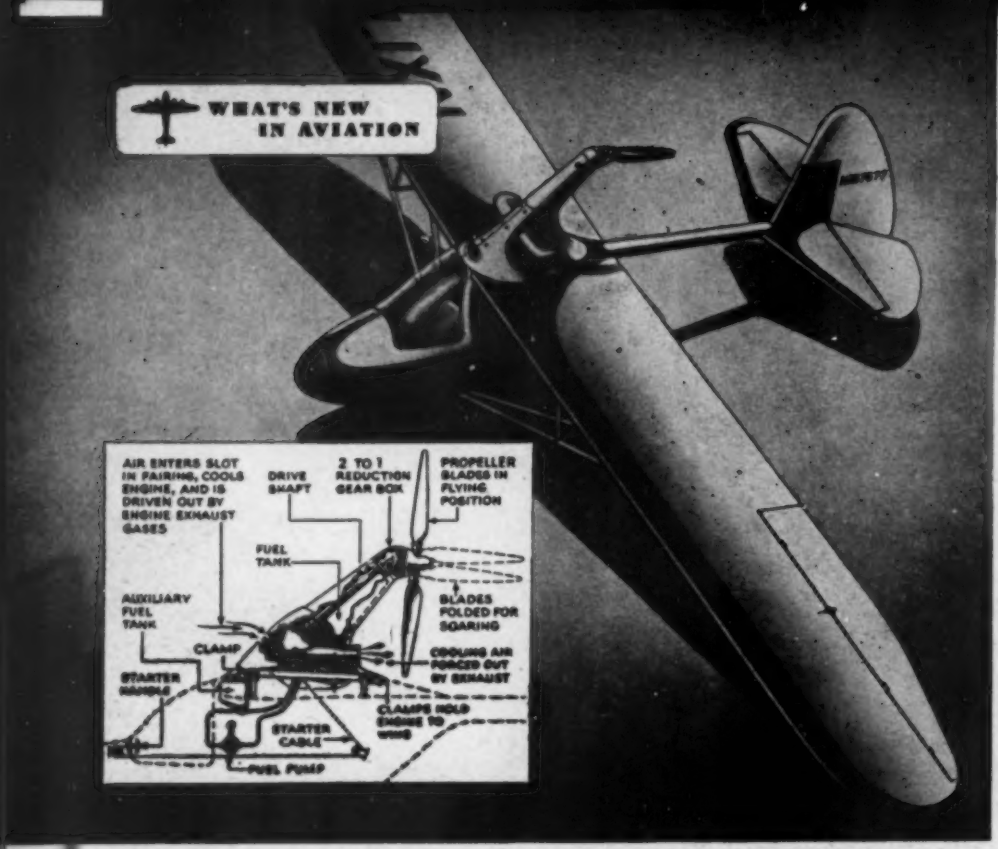
Jet Sheds Weight. You can tuck this 85-lb. turbojet under your arm, but it delivers a 150-lb. thrust. The Boeing Model 500, only 29 inches long and 22 inches in maximum diameter, is adaptable to aircraft, missiles or target planes. High-velocity exhaust gases, heated to 1,500° F., drive its turbine wheel, which is 7½ inches in diameter.

Smallest Man-Flier. This plane, and its twin, are the smallest man-carrying aircraft in the world—and they make 200 m.p.h. Weighing only 530 lb. including an 85-hp. engine, each is 15 feet long, four feet high, and has a 19½-foot wing span. The pair are entries in the new 190-cubic-inch class in the Cleveland Air Races.

One-Hand Control. The "elephant trunk" this helicopter pilot grasps is a new simplified control. Replacing the usual "wobble plate" with a direct connection to the rotor head, it "rolls" the rotor into the desired plane. This increases pitch in one blade and decreases it in the other, steering the 'copter. The new system sharply cuts the number of moving parts, reducing weight and upkeep costs. Developed by United Helicopters, Inc., its principles will be used in a new commercial model.

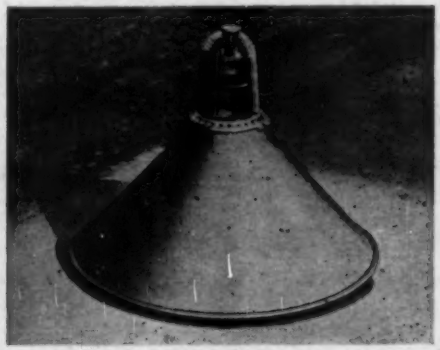
Lighter Self-Sealer. This new self-sealing fuel tank is 40 percent lighter than previous types, which means better performance for the Navy's planes. It is made of the same materials—mostly synthetics—but with improved curing and processing. The Navy and the United States Rubber Company developed the tank.

Heaviest 'Copter Checks Out. The Kellett XR-10, heaviest and most powerful helicopter in the world, has completed its first test flight. Its twin 525-hp. Continentals make over 100 m.p.h.; range is 350 miles. The Air Forces' largest 'copter, it carries 10 passengers or 2,000 lb., plus two pilots. Gross weight is almost 11,000 lb.



Glider Gets "Outboard." Gliders will be able to take off without help of winch or tow with a new auxiliary engine that clips on like an outboard. The whole unit, including fuel and propeller, weighs only 80 lb., so one man can carry and attach it. The 22-hp. engine will take a glider off the ground in less than 500 feet, climb 300 feet a minute, and cruise for an hour. For soaring, the propeller automatically folds back. The flying outboard was designed by E. H. Rowley, Boeing flight-test chief.

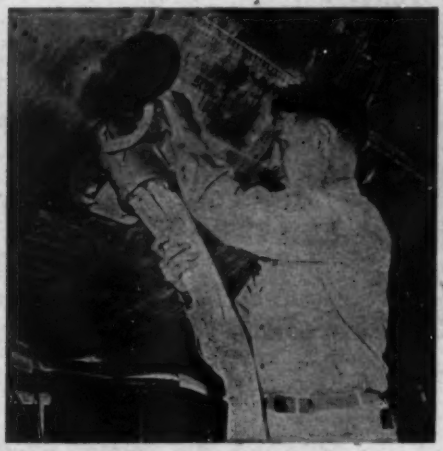
Antenna Cuts Drag. These two antennas do the same job, but the new RCA slotted type (top) eliminates drag on high-speed planes. Set flush, it is plastic-covered.



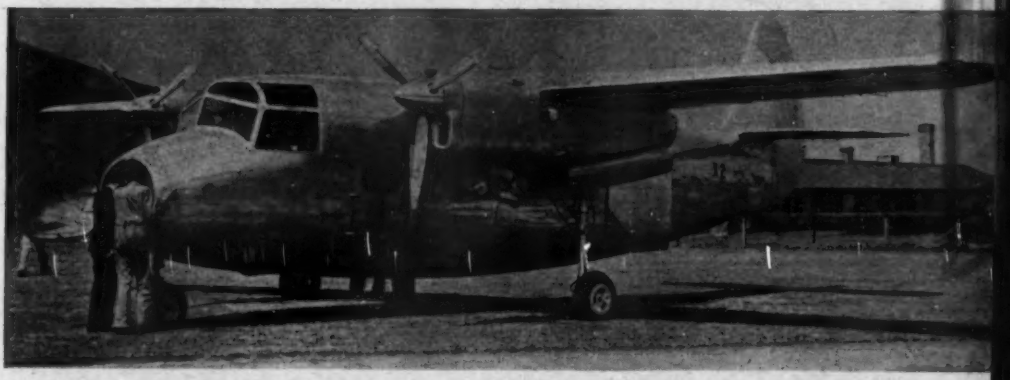
Better Runway Light. This runway marker light sticks its neck out so you can see it. The American Gas Accumulator Co. says it's more visible than semiflush type.

New Light Ends Stargazing. No pilot is likely to confuse a star or ground light with these new plane lights, which outline tail and wing tips with lucite. The Navy developed them after finding that fliers in night formations would miss a single light or, worse, suffer the illusion that it was dipping and crash trying to follow.

Listens to Leaks. Stethoscope applied to rivets catches the hiss of air leaks from pressurized cabin of Northrop's eight-jet YB-49. Leaks are then sealed with compound.



Plugged-In Power. Boeing Stratocruisers have power for air conditioning even when grounded with engines off. Service truck drives up and 28-volt DC is plugged in.



It Packs a Load. Britain's new Percival Merganser may look small, but its cabin holds eight passengers or 1,825 lb. of freight. High wings and low floor help loading.

Front view of a Santa Fe ballast cleaner shows plow and wheel, attached to car by arms that keep it vertical when it is raised or lowered.

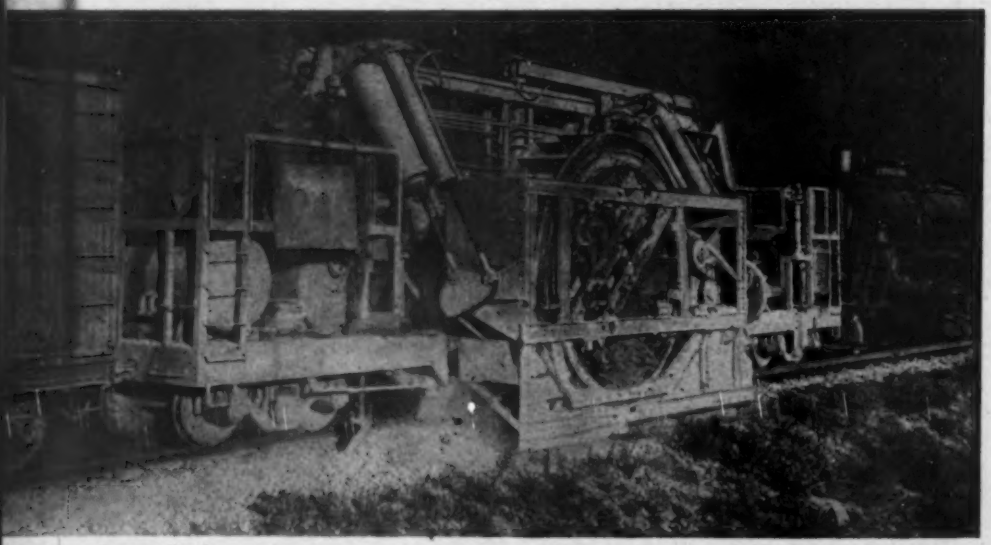
Ballast "Broom" Rides the Rails

KEEPING track ballast cleaned and properly stacked along thousands of miles of U. S. railroads need no longer be a job for pick-and-shovel crews. A single machine, standing 20 feet high on its special flatcar, now gulps up the rock, cleans it and leaves it neatly piled along the ties in a continuous operation.

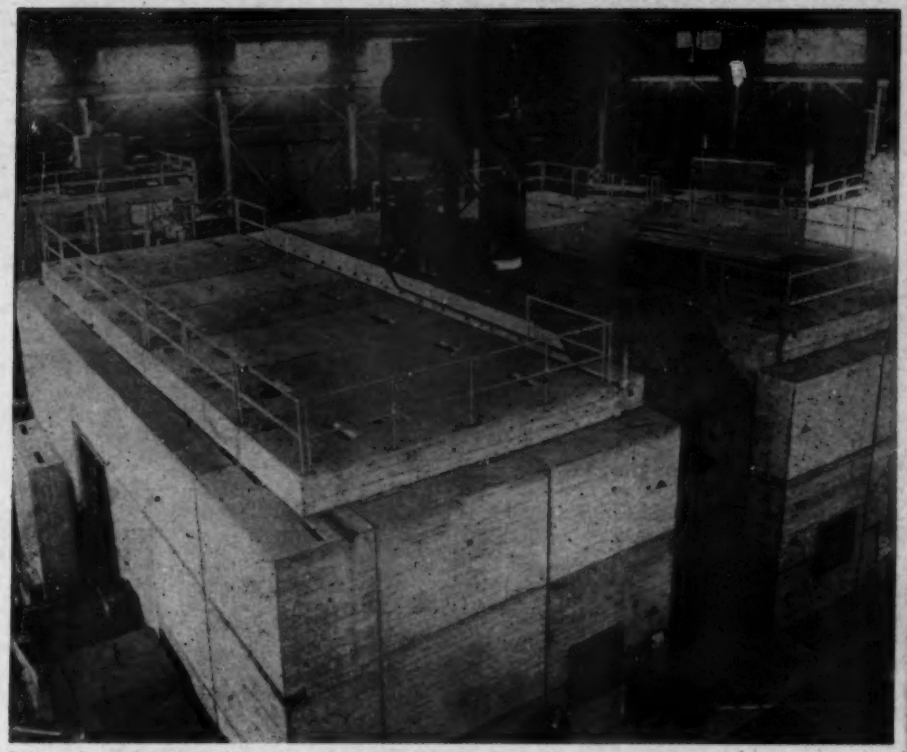
The ballast cleaner has two giant revolving wheels, driven independently by gasoline engines. Plows shape the ballast into ridges so that buckets in the wheels can scoop it up and dump it onto a series of steel "grizzlies," or shaking screens, consisting of closely spaced bars. As the grizzlies rattle, delivering the cleaned rock to the rear of the machine, baffles trap the dirt and deflect it to endless belts that toss it outward on the right-of-way.

Other baffles kick the rock back down on the track shoulder, knocking stray pieces off the ties and returning the ballast to its proper slope and position. Rock fragments too small to qualify as good ballast are tossed aside.

The machine is mounted on special adjustable arms, which allow it to operate over any sort of track conditions.



Drawn by locomotive in reverse, cleaner goes 2½ m.p.h. and can cover 1,250 miles a year.

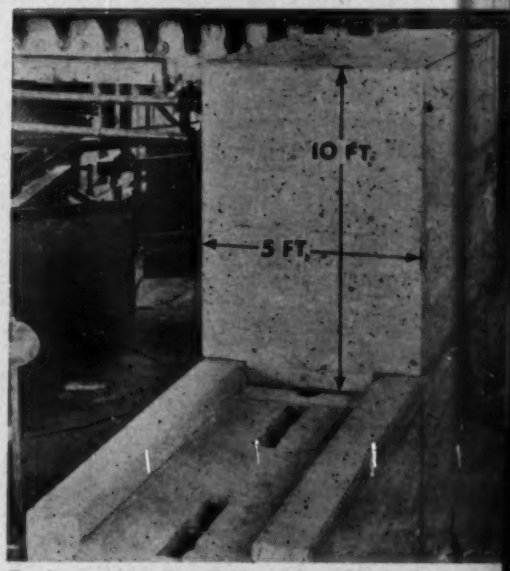


Like a huge bomb shelter, concrete surrounds cyclotron's magnet and acceleration chamber.

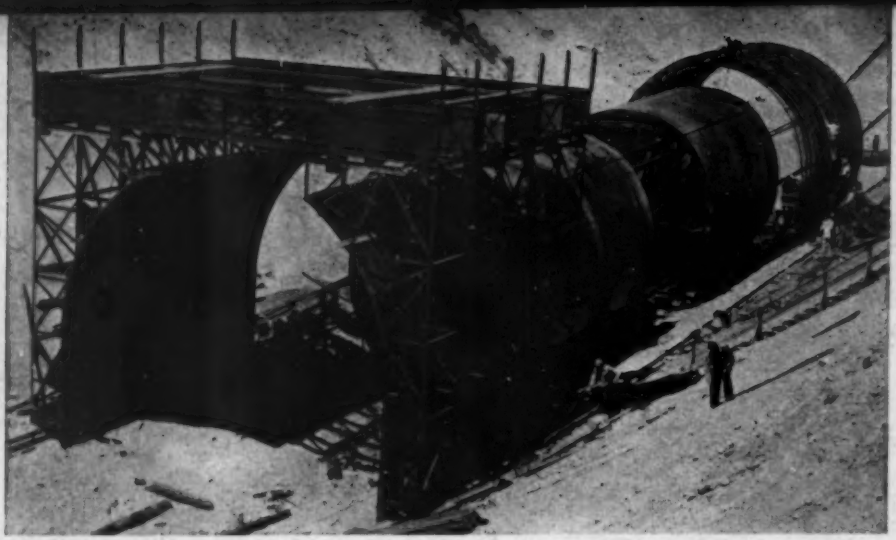
Concrete Blockhouse Cages Split Atoms

A CONCRETE blockhouse with walls five feet thick shrouds the University of California's 4,000-ton cyclotron, the giant now engaged in knocking atomic nuclei to smithereens. Built of 20-ton blocks, the walls shield workers from the deadly radiations of nuclear disintegration.

Concrete was second only to copper among the shielding materials tested, and the five-foot walls whittle the machine's 100-million-electron-volt neutron radiation down to one hundredth of its original strength. So powerful is the cyclotron, however—it blasts out 20-odd nuclear particles as against the two or three freed by prewar atom smashers, and it can be made stronger still—that eventually the already massive shield will have to be doubled in thickness.

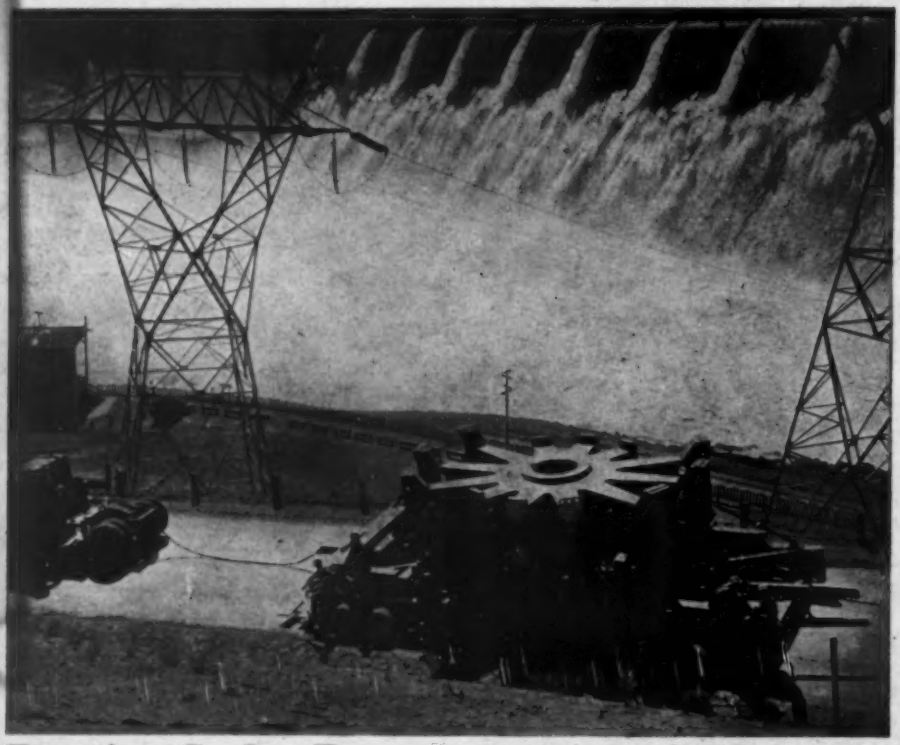


Partly completed wall shows how blocks interlock to bar possible leakage through joints.



Builds Big "Barrels"

THIS $57,000 contraption builds 25-foot irrigation siphons for the Columbia Basin. Concrete is shaped by telescoping inside forms and an outside clamp, then reinforced with the steel hoops at right. The machine can be used repeatedly.



Boosting Coulee Power

EASED downgrade on a 16-wheel trailer, this spiderlike rotor is on its way to the west powerhouse at Grand Coulee Dam, in Washington. There the 60-ton Westinghouse unit will be installed as part of L-7, Coulee's first new postwar generator.

Logging at Full Throttle

The roar of the machine replaces the yell of the lumberjack in America's biggest peacetime lumber boom.

By Thomas E. Riley

THANKS to the gasoline and Diesel engines that serve as the modern logger's muscles, wood is being sped to homebuilders from Pacific Coast forests without devastating the land as of old. Compact motors drag the saws back and forth, and powerful machines rush the big sticks to the mills. As the modern trucks and archcats wind through the smaller trees, they leave seed trees or long blocks of virgin timber, or come back and plant young seedlings, for some western lumbermen are trying to perpetuate valuable timberlands.

In the mornings, the forest is roused by the deep roar of Diesel engines and the staccato barks from the king of the loggers. Once the highclimber, who dared to top the tall spar trees, was king; now the highest wages go to the men in tin helmets—the modern fallers who swing stuttering power saws against the tree trunks.

Speed and Economy

Driven by small one- and two-cylinder engines, the chain saws cut closer to the ground—saving lumber—and they will fall in five minutes a tree that formerly took an hour. Since the fallers are paid by the number of board feet they cut, some of them draw $1,000 a month.

Once a tree is down and trimmed by the buckers, the huge Diesel cats roar forward, grab the logs and drag them over the rough mountainside. Called archcats because of their massive arches, these machines tow the big sticks to the yarding areas. The yarders are strong spar trees, usually Doug-

las fir, braced and rigged with steel cables to handle the logs.

A loader must be able to judge by eye the approximate weight of a log. One man picks out a log from the pile and sets the cable tongs in it. The head loader stands by the truck and signals the winch operator to raise or lower the cables until he is satisfied the log is resting solidly on the truck and trailer.

Loaded, the huge truck roars away. There's a peculiar set of rules for this kind of driving—and no room for mistakes. If you should ever be driving up a private logging road remember that the right-of-way is with the truck going out. *And he takes the bank side of the road.* That truck has an immense load: 20 tons of logs when driving on public roads and up to 40 tons when private roads extend clear to the millpond. The driver must stay away from the outer edge of the road where it might crumble. And those private mountain roads are one-way because of the cost of construction.

The roads are nearly always downhill for the loaded trucks, so they must constantly use their brakes as well as the drag of their geared-down motors. Each truck and trailer carries 150-gallon tanks of water under air

Cutting the niche to direct the fall of Douglas fir, power saws have replaced the crosscut and ax. Note how man at right pushes with stick.

Power-bucking comes next. These men use power saws to trim branches and cut trees into the right lengths for trucking to the mill.

Now the logs roar down the 25 miles to the Willamette River. That's steam, not dust, rising from the water-cooled trailer brakes.

At the end of the private road, the scaler measures the logs and calls them off to the recorder in the shack. Now for the unloading dock.

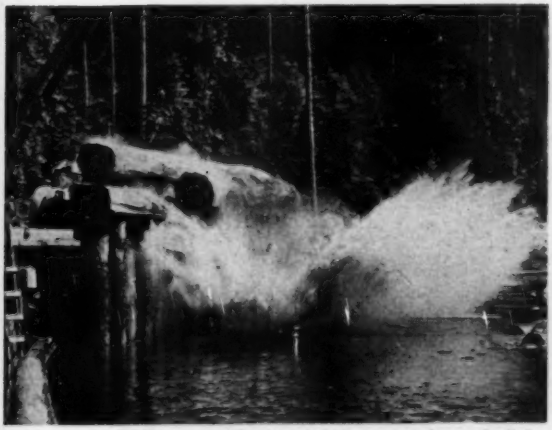
pressure. These squirt streams of cold water on the trailer brakes throughout the trip. Even with the cold spray, the brake drums heat tremendously, turning the water jets into clouds of steam.

After all the big timber is logged, the area is logged again! At first glance, this seems a final blow to the timberland. Actually, one of the main reasons for the second logging is reforestation. The relogging is on a smaller scale with lighter machines, and no more trees are felled. A small Diesel-electric sawmill is set up on the spot and only the tops of the fallen giants, the snags and the other leftovers are cut up into timber. This relogging saves about 7,000 board feet of lumber per acre. It removes much of the slash—worst fire hazard in the woods. And it leaves the land in better condition for the growth of young evergreens.

After relogging, the area is set aside. With the seed trees, it is not the completely denuded stumpland of old. In 20 years the by-passed second growth will be ready to log, and in 40 to 60 years the cones from the seed trees will produce "pole" logs for harvesting. Throughout the area, meanwhile, the gravel roads are left ready to bring in pumping engines and fire-fighting crews in case of fire. END

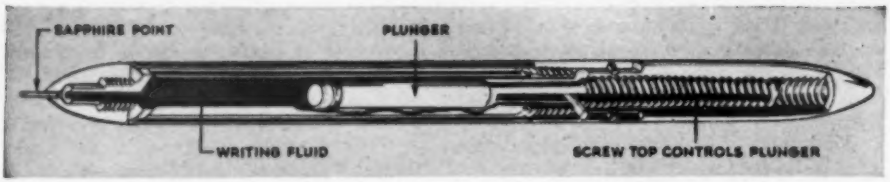
An archeat drags logs to loading point. Arch, on rear of tractor, handles a separate line to each log; it replaces the dangerous high line.

In the yard, the loader groups the logs and loads them on the trucks. A Diesel tractor powers the yarder tree used as a derrick.

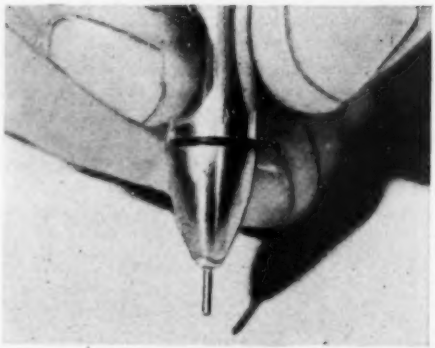


The river, 17 miles farther on, is the end of the trail. The dumper, powered by a gas winch, rolls logs into water, ready for the mill.

Far-sighted lumber companies realize that they must replenish their timberlands. America uses 50 percent more wood than is being grown.



Drawing Pen Inks Itself



HERE's a draftsman's dream come true—a drawing pen that inks itself. Unlike a fountain pen, it produces an even line for fine work, and the quick-drying lacquer used for ink will not spread under a ruler. Capillary action draws the fluid from the reservoir through a fine opening between wall and sapphire tip. Turning the screw top forces down more ink for a thicker line. The pen was developed by L. A. Paul, of Beechcraft Aircraft. So far, only enough are being made for Beechcraft's own use.

Night View at Noon

THE man squatting in the road at right is seeing just how that traffic line looks in the dark. Night drivers often blame tired eyes when markers show up too late for comfort, but the sign may fail to reflect enough light. To find out, this 25-lb. Hunter Night Visibility Meter projects a beam from a six-volt auto lamp onto the paint or sign under test. Through the eyepiece the operator sees a narrow strip of light reflected from the subject, surrounded by light reflected from an illuminated panel of known brightness that can be varied. He adjusts the panel until its reflected brightness just matches the slit, then reads the reflectance value on a scale. An ordinary white traffic marker may read less than 1; a glass-beaded sign, as much as 50.

V-Paddles Run Better

THIS odd paddlewheel may help the sternwheeler stage a comeback. Ease of repair gives this type advantages for river use, but heavy shock loads on the machinery as each paddle in succession spanks the water cause high maintenance costs. With the new V-paddles, the center of one pair hits the water as the tips of another leave it, providing a continual action and constant wheel speed. Tests by the American Rolling Mill Co., which developed the wheel, also show a nine percent cut in fuel consumption.

Squirting out of that hypodermic needle is silk that never saw a silkworm—it was produced in a laboratory at Harvard University by Dr. Robert B. Woodward (above) and Charles H. Schramm.

How to Create Silk, Skin or Serum

Chemists find way to link atoms into gigantic molecular masterpieces that rival nature's own proteins.

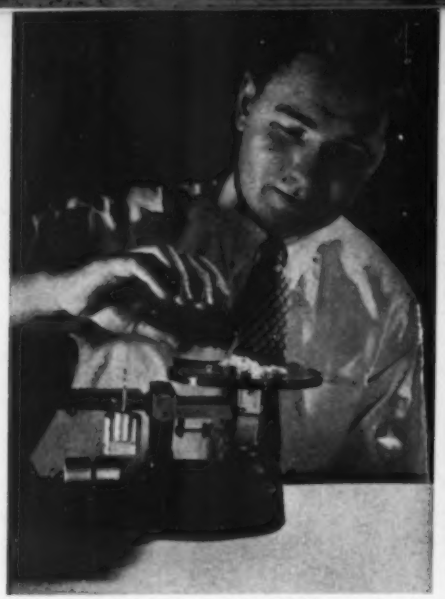
By Martin Mann

PSM photos by Robert F. Smith

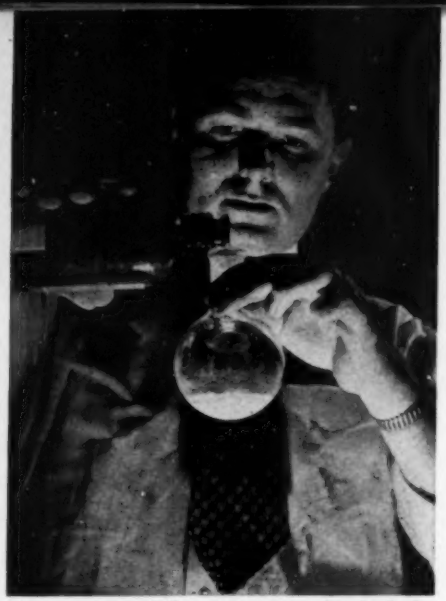
MINK fur is protein. So are silk, beefsteak, and all other animal hair, skin and muscle. The viruses that cause infantile paralysis and influenza are also proteins. The new germ-killers like gramicidin and tyrocidin, while not actually proteins, resemble them in structure. Nature has been producing proteins for millions of years, but men never were able to duplicate these materials until this year.

In a laboratory at Harvard University, Dr. Robert B. Woodward, the 30-year-old chemistry professor who helped synthesize quinine when he was only 27, and his assistant, Charles H. Schramm, have come close to making real protein—and may have done it. They have produced a thin, flexible sheet that looks like cellophane but is chemically similar to natural skin, and they have created a long fiber that is apparently identical to silk.

Chemists have long known that proteins are amino acids, linked chain-fashion into extremely big molecules. They also know how the amino acids "join hands" to become such big molecules. Amino acids are compounds containing carbon, oxygen, nitrogen and hydrogen (some also include another



Schramm demonstrates for PSM's camera the method that may lead to artificial fur, meat, textiles and other proteins. Here he weighs one of starting compounds, an amino-acid anhydride.



Two or more different amino-acid anhydrides are dissolved in benzene to make the solution that becomes a "protein analogue." A tiny amount of water in benzene starts the reaction.

element like sulphur or iodine). When they join together to make the long chain of a protein molecule, a nitrogen atom of one amino acid is held jointly by a carbon atom and an oxygen atom of the neighboring amino acid. This connection, called a peptide bond, is one of the distinctive traits of proteins.

23 Found in Nature

The first amino acid discovered was cystine, in 1810; 22 others have since been found in plant and animal protein, and many others that do not occur in nature have been made in the laboratory. Food researchers recently learned that eight of the 23 natural amino acids are a vital part of the diet—if the food you eat every day did not contain enough of each, you would lose weight, eventually die—and these eight now are used to enrich cereals and other foods and to prepare special diets for hospital patients. One amino-acid compound, monosodium glutamate, or MSG, is also employed as a seasoning. With these exceptions, few amino acids are manufactured commercially, although the raw materials are widely available and cheap. Amino acids can be built up chemically or obtained from natural proteins such as the wastes from canning factories and slaughterhouses.

Although proteins could be broken down into amino acids, no one could reverse the process and put amino acids back together again into proteins. The amino acids just would not polymerize, or join in a very long chain. Emil Fischer, the great German chemist who did much of the early work on proteins, tried it in 1907. In a complex series of reactions, he got 18 amino-acid groups to hook up into a chainlike molecule. His student, Abderhalden, raised him one and made a chain molecule of 19 amino-acid groups. But these 18- and 19-group molecules were not big enough to be proteins; the shortest real protein molecule contains about 100 groups, and others extend beyond 10,000 groups.

That was the best anyone had done until Dr. Woodward, during a railroad trip from Boston to St. Louis, thought of a way to get the reluctant amino acids to polymerize. A check on the work of other men revealed that the process itself had been used previously for different purposes. It had been discovered independently by three different research teams, starting with the German chemists Leuchs and Geiger in 1908.

Others Missed the Point

All these scientists, however, had missed the importance of the reaction: that it might produce very long amino-acid chains, or proteins. Realizing this, Dr. Woodward and

Heating the solution makes the anhydrides join together into long proteinlike molecules in 10 hours. Without heat, the process works just as well, but takes longer—about two weeks.

The result is a molasses-thick fluid that dries in air to a synthetic apparently identical with real protein. In the photo above, a film of it is being made by pouring the fluid on a plate.

Schramm went to work; by last June, they had produced several man-made substances that seem to be proteins.

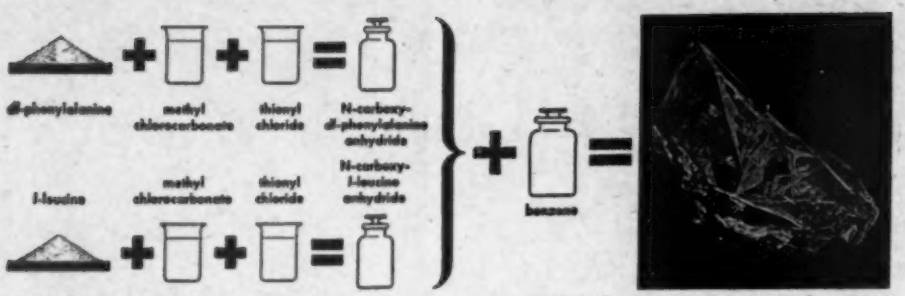
Their process is simple. They treat amino acids to remove oxygen and hydrogen from their molecules (the oxygen and hydrogen come out in the form of water—H_2O). Two or more of these treated amino acids, called anhydrides, are then mixed in benzene (not benzine), and the solution is permitted to stand until it thickens—from a few days to two weeks. This thick solution dries quickly when exposed to air, giving the proteinlike material.

20,000 to the Inch

Squirted out of a hypodermic needle, the solution becomes a fine thread very similar to real silk. Poured on a glass plate, the same solution dries to a transparent, stretchy sheet that looks like cellophane, but chemically is more like natural skin. The sheets already made have been extremely thin—some so filmy that 20,000 of them would have to be piled up to get a stack one inch high. However, thick blocks of the same stuff could be made just as easily.

Dr. Woodward explains that water (a tiny amount present as an impurity in the benzene) starts things going by combining with the anhydride to form an intermediate compound. The intermediate compound quick-

This is the finished "protein analogue"—a thin film that looks like cellophane but actually is more like natural skin. Thicker sheets or even solid blocks could be made in the same way.



The simplicity of the process for creating protein is illustrated in this chart. Amino acids (obtainable from plant or animal materials or built up from chemicals) are treated to remove oxygen and hydrogen atoms, giving the amino acid anhydrides (two bottles in center). These anhydrides are then mixed with benzene to yield synthetics rivaling nature's own proteins.

ly breaks up into carbon dioxide and an amino acid. This amino acid has an "active center"—sort of an outstretched hand reaching for another anhydride. When it catches another anhydride, it hooks on with a peptide link, and at the same time changes its newly acquired neighbor into the intermediate compound that loses carbon dioxide and develops an active center. This process continues until no more anhydrides are left to catch. Molecules made up of more than 10,000 amino-acid groups have already been made in this fashion, and Dr. Woodward believes any size molecule is possible if enough anhydride is used.

Length Indicates Likeness

That these synthetic molecules are extremely long indicates that they are at least reasonable facsimiles of true proteins, for protein molecules are the only ones known to be so large. The synthetics also meet other requirements for a protein: They are made of the same raw materials (amino acids) joined together in the same way (through peptide bonds).

Still, Dr. Woodward cannot be positive he has a true protein, for he doesn't know how the amino acids are *arranged* inside the molecule. Suppose he starts with three amino acids—call them A, B and C. They might join up in the order AAABBBCCCAAA. . . etc., or perhaps ABCABCABC . . . etc., or any of countless other combinations. Since the arrangement makes the difference between an exact duplicate of a natural protein and a good imitation of one, Dr. Woodward cautiously refers to the synthetics as "protein analogues."

If the arrangement of the amino acids inside the molecule can be controlled (and Dr. Woodward believes it possible), then many of the proteins that we use every day can be manufactured. This would mean the birth of an entirely new industry, as did Perkin's discovery of synthetic dye in 1856, for the list of things that might be made cheaper and better than natural products is almost endless.

Luxurious furs could be "grown" in chemical factories. Would you like mink, sable or fabulous chinchilla?

A true synthetic silk (rayon is entirely different chemically) could be spun from the test tube. Already the Harvard chemists have made a fiber that seems to be the same as silk.

Wool, however, would be more difficult to duplicate, since its fiber possesses peculiar scales. The scales might be synthesized, Dr. Woodward thinks, but attaching them to the fiber as nature does would be quite a tricky problem.

Much more must be learned about protein analogues, Dr. Woodward emphasizes, before any of these miracles will become commonplace. Textile experts, for example, wonder if synthetic fibers would be as strong as natural fibers. Could they be washed? Would they take dyes? How long would they wear? And what would they cost? These and many more such questions remain to be answered.

A Clue for Biologists

To biologists, a process for making real protein would have revolutionary importance, for it might reveal how the human body produces its own proteins. The human chemical factory is continually changing amino acids into the special proteins needed for muscles, tissues, hormones and various other parts of the body. That much is known. But how this building-up process

works has always been a mystery. An explanation of it would answer many questions in medicine.

A method for duplicating natural protein would be extremely valuable to medical scientists, yet it would not satisfy organic chemists. They are never content to imitate nature's handiwork, but try to make something better, preferring to design an artificial molecule that will do a particular job more effectively than any natural molecule. Nylon is an example of a custom-built synthetic molecule. Chemically it bears only a slight resemblance to natural silk, yet it makes better stockings than real silk.

Reshaping Nature's "Bricks"

The method discovered by Dr. Woodward and Schramm may facilitate this sort of molecular architecture. Chemists may produce molecules similar to natural protein, but different enough in composition or shape to be more useful. Merely changing the length of a natural molecule, for example, might result in leathers and silks possessing all the advantages and none of the disadvantages of the natural product.

Slight differences in the structure of a wool-like molecule could give synthetic wool that would never shrink, no matter how many times it was washed. It may even be possible, one chemist thinks, to make a wool molecule with a built-in DDT group; the foolhardy moth attacking a synthetic wool suit would die after the first bite!

Tools for War on Germs

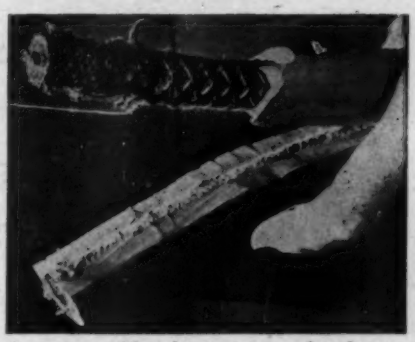
Some of the new germ-killers, such as gramicidin, bring swift death to bacteria; unfortunately they are just as poisonous to men. For that reason they can now be used only for surface cuts, never internally. But, suggests Dr. Woodward, a synthetic gramicidin with molecules longer than the natural ones might turn out to be harmless to man yet just as deadly to bacteria. He has already synthesized one possible germ-killer, which is now undergoing tests in medical laboratories.

A similar technique could be used on viruses. The chemists might be able to make a virus similar to the one that produces infantile paralysis, yet different enough so that it would only cause a mild case of the disease. This weak virus would then serve as a vaccine to protect against infantile paralysis—the way mild cowpox serum protects against smallpox. END

Putting a crucible into first electric furnace for commercial small-batch glass making.

Smallest Glass Factory

THIS tiny factory turns out glass in one-pound lots—and does it commercially. The product is used in making minute bulbs, weighing only 1/10 gram and only .0045 inch thick, for electrodes required in measuring acidity. The glass, made by Leeds and Northrup, of Philadelphia, has a high conductivity in the presence of extremely small voltages.



Cutaway cable shows copper braid over the line's inner core, within rubber jacket.

Braid Bans Sparks

EVEN if this cable shorts, there will be no dangerous shower of sparks. A copper braid between insulation and jacket picks up any current leakage and carries it back to a circuit breaker. Made by the United States Rubber Co., of Salt Lake City, it is designed for power lines to mine machines, where arcs from leaky cables sometimes explode dust and gas.

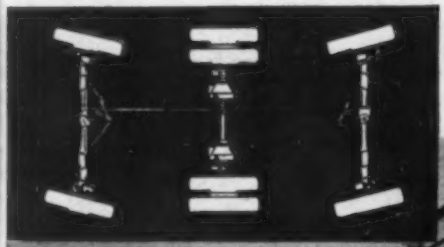
Sway-Backed Bus Cuts Corners

As long as three cars, bus seats 58 persons,

EQUIPPED with steerable wheels both front and rear, a two-section bus produced by the Twin Coach Co., of Kent, Ohio, turns corners with greater ease than any conventional bus now traveling city streets, although it is a dozen feet longer than most.

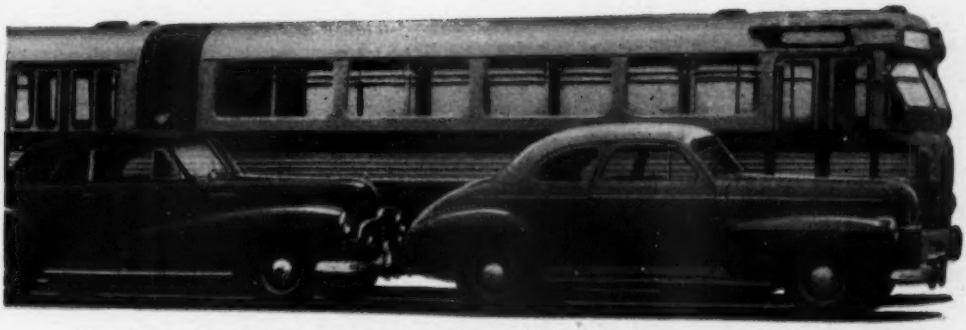
When the driver steers, a connecting shaft turns the rear wheels simultaneously with those in front, the rear ones turning outward and swinging the back of the bus around the corner. In effect, therefore, the vehicle pivots on its driving wheels in the center. By virtue of this double steering, the 47-foot bus can turn in less space than an ordinary 35-foot bus.

A hydraulic booster system, actuated by two buttons under the driver's left foot, provides power to steer the four wheels whenever it is desired. One button operates the left-turn booster; the other, the right-turn booster, making the bus as easy



On turns, the rear wheels follow the path of those at the front. This has the effect of pivoting the vehicle on the center driving wheels, allowing it to turn in a radius of 35 feet 10 inches, including overhang at both ends.

When the driver steers, both the front and rear wheels turn—but toward opposite sides.



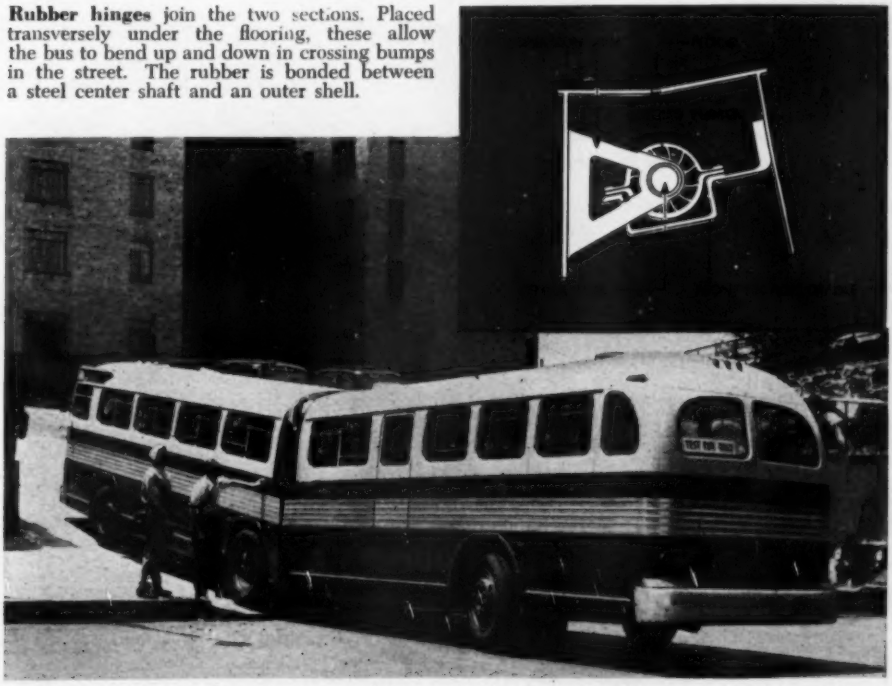
but the total capacity of its two sections—120, including standees—rivals a streetcar.

to handle as a much smaller one. The driver has no clutch pedal, since torque converters eliminate gear shifting.

Joined just behind the center axle by two Torsilastic rubber hinges, developed by the B. F. Goodrich Co., the two sections of the bus undulate when they hit a hump or dip in the road. Similar in construction to the springs employed on all three axles, the hinges consist of rubber bonded between an inner steel tube and an outer shell, the rubber absorbing the twist when force is applied to either tube or shell. Sheets of rubber connect the top, sides and floor of the two sections. This rubber flexes as the center of the bus rises and falls.

Powered by two 180-hp. Fageol gas engines, under the rear of the front section, the bus can travel 75 m.p.h., although normally it would never have to operate at that speed. Built chiefly of aluminum, it weighs about 22,800 lb. END

Rubber hinges join the two sections. Placed transversely under the flooring, these allow the bus to bend up and down in crossing bumps in the street. The rubber is bonded between a steel center shaft and an outer shell.

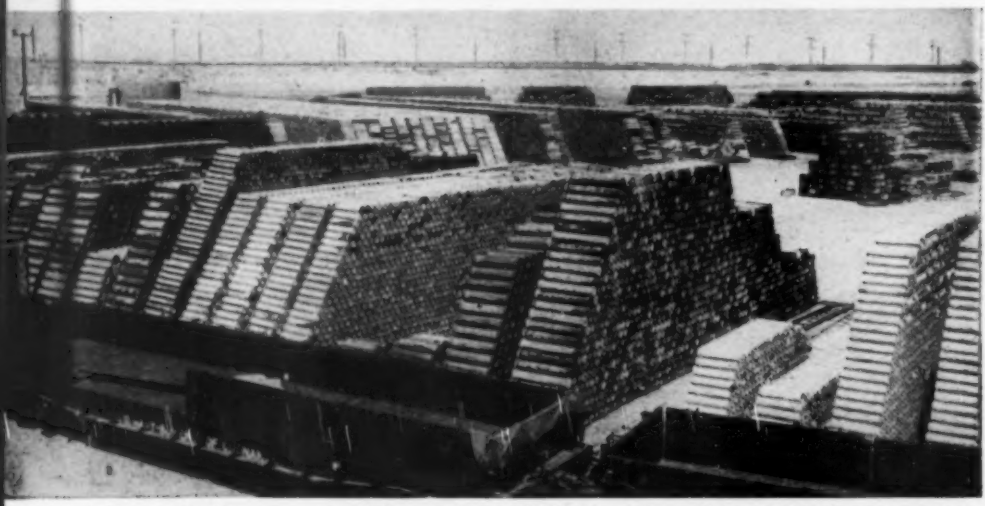


Bending of the bus keeps the center driving wheels always in firm contact with roadway.

5,000 Acres of Sudden Death

DEATH—potentially—for thousands lies close to populous Long Beach, Calif. Yet so tightly is it leashed by safety precautions that danger of major disaster is at a minimum. The thousands of tons of munitions at the 5,000-acre Seal Beach Naval Ammunition Depot are scattered in small lots in "igloos." Employees are highly trained in safety; to prevent sparks they use bronze tools and wear shoes with no metal in them. Greatest danger is from above: civilian pilots who fly low over the area, never suspecting what it contains.

These safety-minded workers are inspecting and checking the gauges of three-inch AA shells.

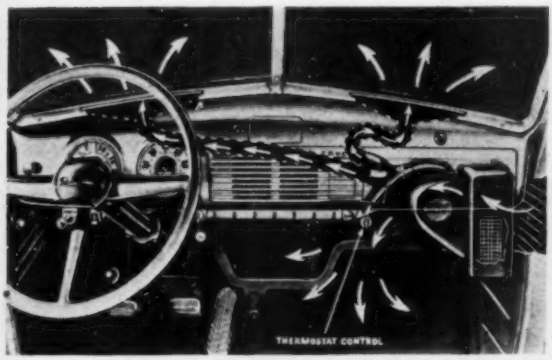


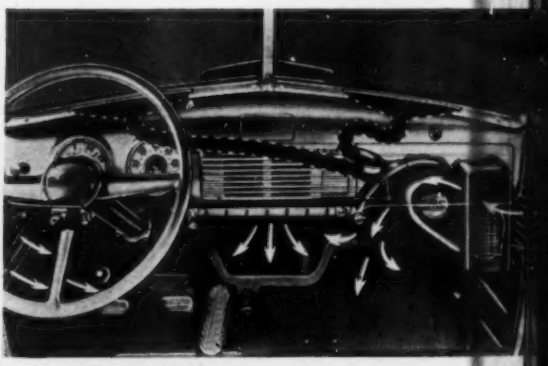
These vast piles are empty shell containers of all sizes, from rifle to 16-inch ammunition.

Farm Jeep Again Offers Four-Wheel Drive

HERE's the latest member of the growing jeep family: a farm truck with the four-wheel drive of the wartime model. With a full 2,000-lb. load it can climb a 48 percent grade. It is designed for farmers who must drive to market over bad roads in all kinds of weather. The driver can shift to ordinary two-wheel drive whenever he wants to.

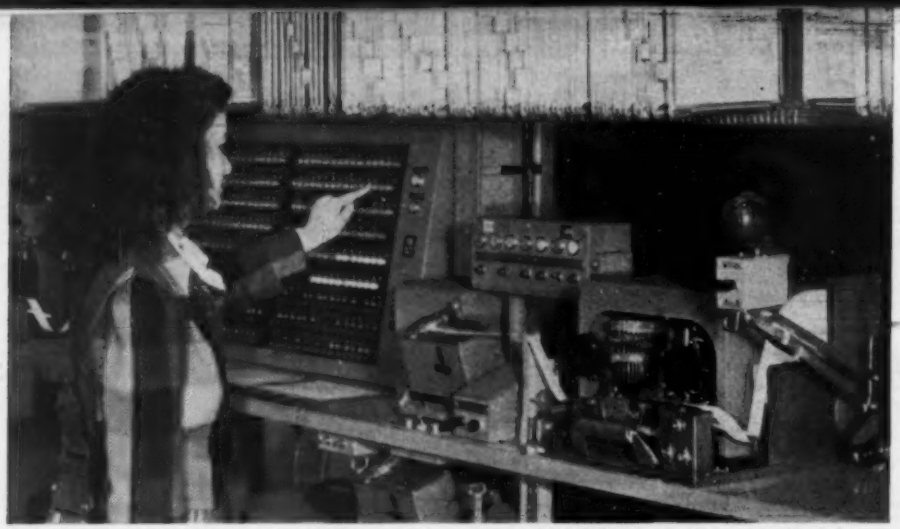
Other than the front axle and transfer box, most engineering and body details of the Willys 4WD are identical with those of the two-wheel drive model. Appearance is the same except for distinctive colors. There are seven body styles. Optional features include power take-off, shown in action above, and variable-speed governor for towing.





New Trucks Built for Driver Comfort

THE driver gets a break in the new GMC light- and medium-duty trucks. Cabs have been redesigned to provide more room, a more comfortable seat, increased visibility and improved ventilation. The pictures above show how the ventilating system works. In winter (at left) the system draws in fresh air, heats and distributes it. Connections with vents under the windshield provide a defrosting system. Stale air is expelled through openings in the floor of the cab behind the driver's seat. In the summer setup (at right), a steady stream of cool, outside air is sucked into the cab. Other improvements have been made in the engine and chassis of the trucks.



Pushing the right button now relays a telegram through switching centers to its destination.

Buttons Relay Telegrams Faster

YOUR telegrams will soon get there nearly twice as fast, hastened by a new system of push-button switching that speeds messages through Western Union's big central offices. The five minutes or more formerly required to relay a telegram are being cut to seconds, while the number of messages an office can handle is being boosted.

Relay points have always been a major bottleneck in telegraph service. Until now, a message from a branch office was sent to the nearest switching center, where it was printed out on paper tape, pasted on the usual yellow blank, and routed by conveyer belt and messenger to an operator at an outgoing transmitter that was connected to the message's destination (or perhaps only to another switching center near the final destination). The operator manually retyped the message, and, if another relay point was involved, the same telegram was typed there for the third time. Many attempts had been made to streamline this method—even to equipping the relay messenger girls with roller skates—but it remained slow and inefficient.

Now push buttons will do the job. The message from the branch office is received at the switching center in the form of a perforated paper tape (the holes in the tape make up a letter code, much as the holes in a player-piano roll make up a music code). Above the punched holes, the message is also printed out. A clerk at the receiver reads the address on the tape, then pushes a button that connects an automatic transmitter to an outgoing transmitter connected to the destination. The tape runs through the first transmitter and is relayed without manual retyping.

Conversion of the Philadelphia switching center, biggest in the country, to push-button operation will be finished this month, with other offices scheduled to change over to the new system by 1950. Already in use are similar installations in St. Louis, Richmond, Dallas, Atlanta and Oakland, Calif.

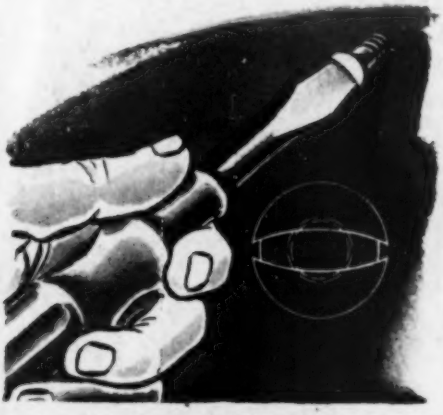
Completely automatic switching—eliminating the need for an operator to push the switching button—is now being developed. With this equipment, certain code letters in the address would trip relays switching the message through to its destination.

This Month's Pin-up

REPUBLIC's P-84 Thunderjet, a contender for top speed honors in the AAF, is powered by an axial-flow TG-180 jet that has blasted it up to 619 m.p.h. in unofficial tests. The sleek, midwing fighter has a range of more than 1,000 miles, a service ceiling above 40,000 feet. It is 37 feet 5 inches long, with a span of 36 feet 3 inches.

Blast Breaks 'Chute's Fall. The force of an explosion is used to soften parachute landings in this invention of Henry S. Bacon, of West Roxbury, Mass. Set off by a weighted release cord just before the 'chute's load strikes the ground, the explosion expands a telescoping chamber. This jerks the canopy and load abruptly toward each other, increasing the air resistance to the canopy and momentarily imparting lift to the load.

Phone Keys Speed Calls. To call a number on this novel phone, you simply tap it out on the keys indicating the appropriate numerals and letters. Invented by Charles D. Richard, of West New Brighton, N. Y., the push-button system is similar in principle to that of dial phones but eliminates the time the dial takes to spring back to its starting position after each turn.



Screw Slot Stops Sideslip. Safe and simple screwdriving is the object of a screw head patented by William L. Todd, of Fort Thomas, Ky. Narrowing at each side, its groove tends to center the screwdriver and keep it from shooting off into a nearby finger or the surrounding woodwork. The best results are obtained with a screwdriver whose blade exactly matches the groove.

Extra Wheels Park Car. You'd have no trouble slipping your car into a tight spot with the parking wheels invented by Abba Miller, of Cleveland, Ohio. Lowered into position by automatic jack units and chain-driven by a separate motor, the tiny transverse, retractable wheels permit the car to move sideways in either direction. (Readers may remember seeing this idea in "I'd Like to See Them Make" last January.)

Pipe-Washer Fits Faucet. A simple pipe-rinsing device that fits over the faucet and directs a stream of water into the pipe's bowl has been patented by Bruno L. Pape, of New Braunfels, Tex. Made of rubber, it has a conical opening at the top that accommodates a variety of faucet sizes. The bottom fits into a pipe bowl, but also fits pipe stems and cigarette holders.

Suitcase Rolls On Wheels. You can roll your suitcase along like a wheelbarrow, instead of having to carry it, with the attachments patented by John M. Hendrick, of Burbank, Calif. The two small wheels near the bottom at one end do not touch the ground until the suitcase is tilted upward. The handle on top at the other end slides out of the way when not in use.

Changes in sapphires lasted longer than those in other stones used in recent tests. These stones were shown at the American Museum of Natural History. The two almost colorless ones in the lower right-hand corner above are untreated; the deep shades of the other four were induced by X-rays.

X-Rays Paint Gems

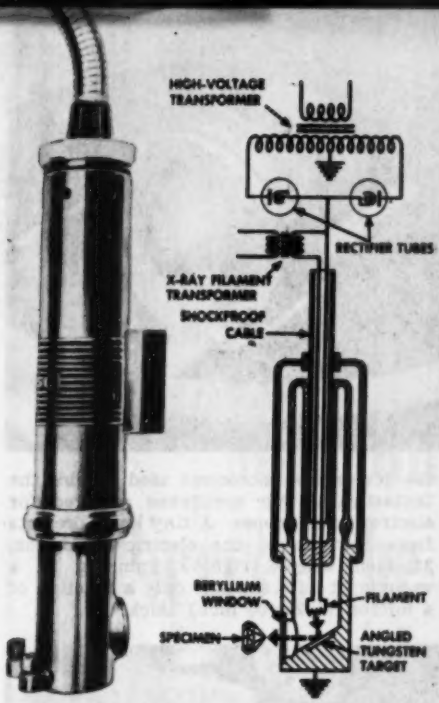
WANT to change the color of the stone in your ring? Or how about one that glows in the dark? Such effects may result from electronic changes temporarily produced in certain precious and semiprecious gems by exposure to X-ray irradiation.

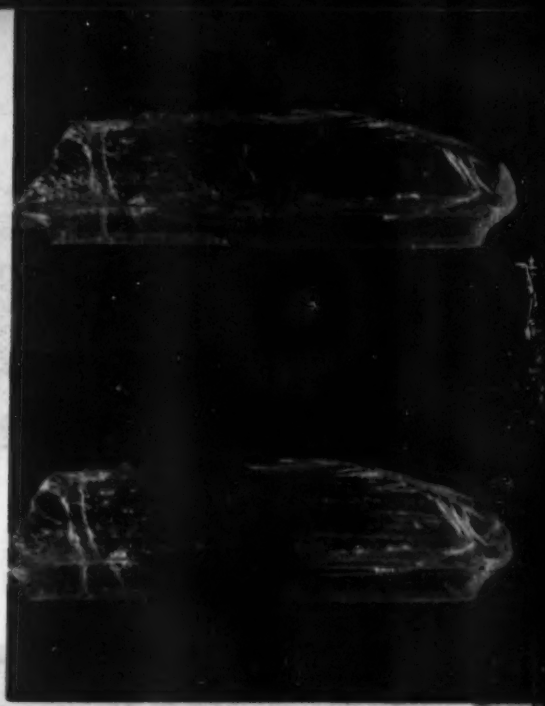
Under the bombardment of special tubes whose rays are several hundred times more intense than those of old-style, conventional types, the electronic arrangements of many gems undergo slight but significant changes. Electrons, separated from their ions, wander free until trapped by structural defects, producing new electronic patterns. These, in turn, cause striking color changes and in some cases even luminescence, found to be valuable in mineralogical studies.

Highly unstable, however, these new arrangements soon revert to their original ones, some without stimulation, others upon exposure to heat or sunlight. Thus, cautious buyers can protect themselves by testing stones with heat and light to see if their colors fade. Diamonds and emeralds are unaffected by the X-ray tubes now in use.

PSM photos by Robert F. Smith

Before exposure: A large 35-carat cut kunzite with (l. to r.) cat's eye, yellow scapolite and white sapphire.





With high-intensity tubes like the one above, radiation effects requiring several hours with ordinary apparatus can be obtained in as little as one minute. Developed by Machlett Laboratories, this 50,000-volt tube uses an angled tungsten target to reflect the rays through a special beryllium window.

Most spectacular change occurred when a virtually colorless piece of untreated spodumene (top photo, above) was exposed to the irradiation. Becoming brightly phosphorescent, it glowed like a burning coal for an hour. Later, a band of vivid green (bottom photo, above) became visible.

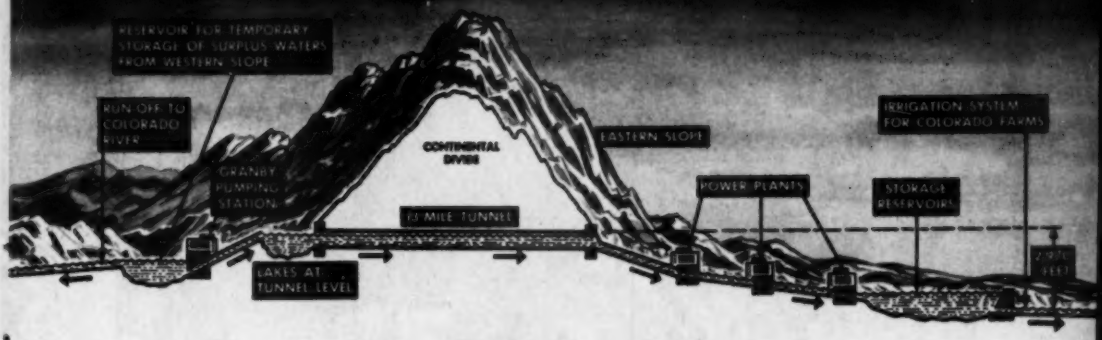
After exposure: Color, changes are startling but brief, would raise value from $500 to $2,000 if permanent.

123,000 R.P.M.

A WHEEL that spins at 123,000 r.p.m., nearly double the previous world's record for rigid-shaft rotation, has been developed in General Electric's laboratories. Shown above with its designer, Dr. E. F. Fullam, the device is a microtome used to slice the fantastically thin specimens required for electron microscopes. A tiny knife projects from the rim of the electrically driven, 3½-inch wheel (right). Spinning in a vacuum, it cuts samples only a fraction of a micron (1/25,400 inch) thick.

Coffee Under Pressure

USING the pressure-cooker principle in a coffee pot, this electrically heated machine turns out the morning brew by forcing superheated water through coffee specially prepared in porous, podlike containers, each of which makes only a single cup. A container is placed in a small pan (at left, above) that locks to a fixture just above cup-rim height. Moving the handle (at right) allows the water to flow through the container and into a cup. A gauge and relief valve guard against excessive pressure.



Man-Made River Pierces the Great Divide

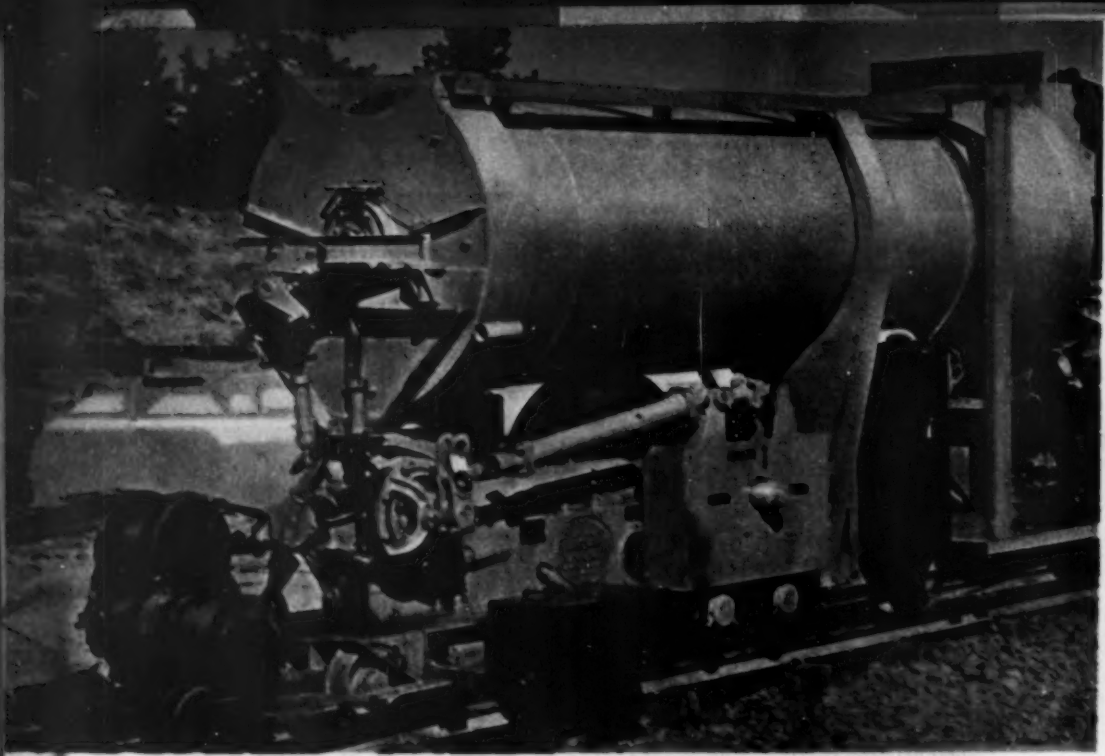
PIPED through the Rockies, an artificial river is available now to refresh thirsty farm lands of eastern Colorado with completion of the Big Thompson project, world's biggest transmountain diversion feat. Cascading through electric generating plants and canals, the torrent will develop 176,000 kilowatts of electricity and boost crops on 615,000 acres.

On the western side of the continental divide, where Granby Reservoir collects rainfall that formerly spilled to waste in the Pacific Ocean, pumps raise the water 179 feet to Shadow Mountain and Grand Lakes. Thence, up to 247,000 gallons a minute course through the $12,400,000 Alva B. Adams Tunnel, a 9¾-foot bore piercing 13 miles of solid granite. Having spun the turbines of hydroelectric plants, the life-giving flow is released through the Big Thompson and Poudre Rivers and a system of canals into territory where, tree rings show, soil has been parched for at least 300 years.

Engineers estimate that the quantity of water should be sufficient to supply a city as large as Philadelphia and Boston combined, and that as much electricity will be generated as a metropolis with the population of Newark, N. J., would consume. Augmented production from farms will amount to $20,000,000 yearly.

At top capacity, 247,000 gallons of water a minute will flow into this portal of 13-mile bore, one of the world's longest tunnels, emerging 107 feet lower at eastern end.

Crews drove eight miles of tunnel, more than half of length, from east portal, below. On best day they advanced 74 feet. Shafts from opposite sides met only ¾ inch out of line.



Tunnel-building train. To give the 9¾-foot shaft a waterproof lining, the odd machine above, resembling a locomotive, pumped concrete into hollow space between rock walls and temporary steel sections assembled to make a cylindrical form. Behind it, apparatus on flatcars kept it supplied with a continuous stream of materials.

Where artificial river starts flow. This scene shows construction of dam creating Shadow Mountain Lake, one of the two reservoirs to which surplus rainfall will be pumped from the Colorado River by way of the Granby collecting basin. From this point on, water runs by gravity to generating plants and farms on opposite side of continental divide.

An inclined conveyer to pumping machine received concrete from mixer, center, to which second conveyer delivered crushed stone and cement from hopper at right of it. Third conveyer filled hopper from compartmented mine car at extreme right, loaded at stock piles. Harnessing labor-saving machinery to job made the project feasible.

Moving mountains. Enough rock to make several respectable foothills came out of the $12,400,000 Alva B. Adams Tunnel—and much of it, after being crushed and piled as below, went back into the concrete lining. In addition, some parts of tunnel had to be permanently braced with steel to prevent cave-in under the terrific overhead weight.

Laboratories Match Men and Machines

Research program strives to simplify equipment that has grown too complex for ordinary humans to handle.

EVEN the scientists now realize that some of the machines of modern life are too complicated for ordinary humans.

So psychologists and engineers at Johns Hopkins University, working under a contract with the Office of Naval Research, are trying to find the best way for men and machines to work together. At the Johns Hopkins Homewood campus in Baltimore, Md., and a field laboratory at Jamestown, R. I., scientists are conducting a basic investigation of how humans react to signals—through sight, hearing, and touch; how they interpret these signals; and how they use that interpretation to send new signals to another machine or man. The investigation covers every question from what is the most crankable crank to how fast a man can copy numbers read over the phone.

With the answers to those questions, the scientists hope to design simpler, more foolproof equipment. They anticipate the end of engineering nightmares like the control system of a big airplane, now so complex that pilots sometimes pull the wrong lever.

Already the search for the most crankable crank has produced results that might be applied to such everyday gadgets as lathe controls or automobile window handles. Dr. Clifford T. Morgan, who directs the entire research program and also supervises the crank-turning project, says that the shortest cranks are the best, unless there is considerable resistance. In that case, the crank should be a certain minimum length for easiest turning.

Knobs, too, may no longer be just any old knobs. By using different sizes for different controls, a radio operator might pick out the right one in the dark by feeling its size. Experiments conducted so far indicate that it is easiest to distinguish size differences by feel if the knobs are fairly large—two to five inches in diameter. The possibility of telling knobs by shape is being investigated by a group at the AAF's Aeromedical Laboratory, Wright Field, O.

What about telling time? Yes, they're working on easier ways of doing that, too.

Inside the "padded cell," a specially built soundproof room, Dr. W. R. Garner shows how ear response is tested in research aimed at a blind-flying system using sound signals.

Curved toy train track (hidden behind black paper) and cars bearing tiny lights measure ability to estimate angles—important for operators of complex control panels.

A Johns Hopkins engineer describes testing device expected to lead to improved radar air-traffic-control equipment. It measures how fast an operator can move a stylus (center of apparatus on table) along a given path on a paper or screen.

Automatic electronic equipment, governed by cams, produces imitation target "pips" on radar screens for scientifically controlled experiments with radar observation methods.

Technicians operate manual equipment also used to control radar images. Real planes are not used as targets, since pilots could not fly same course again to repeat tests.

A V-2 space laboratory takes off skyward. Blossom project's new instrument-recovery method promises more results from tests.

'Chutes Save Rocket Secrets

Instruments fired from soaring V-2s in Blossom project float down safely with vital records of the upper air.

By Stephen L. Freeland

QUEER things can happen to rockets once they are in flight. Some spin like a rifle bullet, some wobble like a top running down, some turn end over end, some change direction, and some misbehave all four ways. The whole story can not be told yet, but means of explaining such erratic behavior have been developed by the AAF's parachute, electronics and photographic experts and scientists of Philadelphia's Franklin Institute Research Laboratories, working together on "Blossom" projects.

Last Feb. 20, some 68 miles above the White Sands Proving Grounds, a small aluminum canister—15 inches in diameter, 30 inches long, weighing 75 lb. loaded—looking much like two little ashcans fitted together, was shot out of the side of a V-2

Test equipment packed in this ashcan-like container, shot from V-2 warhead by mortar, floated safely to earth on ribbon parachute.

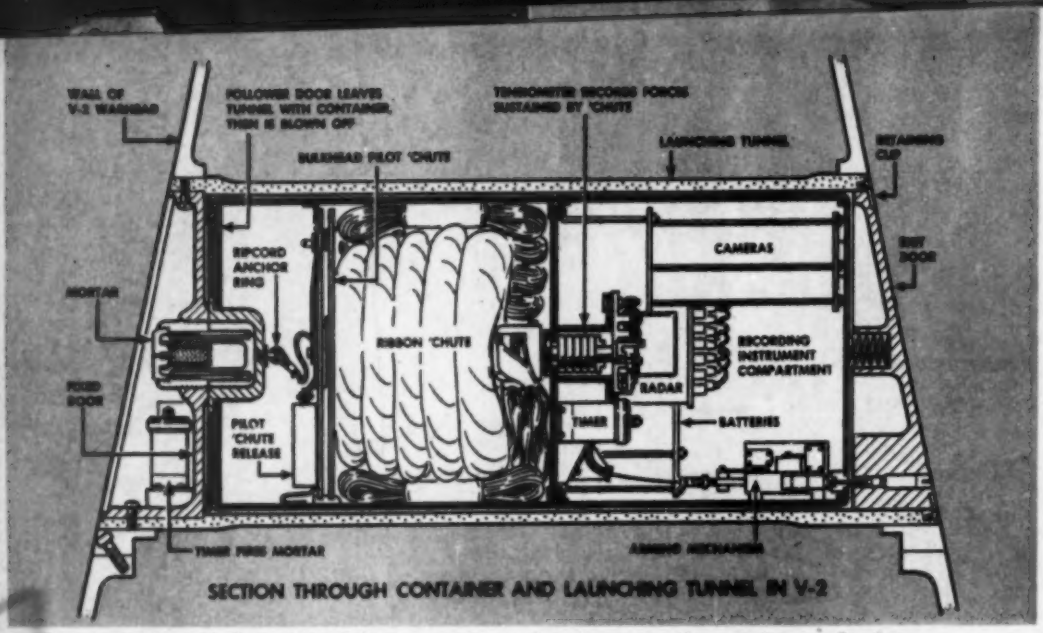
Ribbon parachute's ability to "bring 'em back alive" was demonstrated when one landed an entire Wac Corporal from 40-mile altitude with no damage to the rocket.

warhead. About 44 minutes later, swaying gently beneath the canopy of its ribbon 'chute, that canister touched the ground as gently as a feather. It bounced once, lightly, and came to rest. When it was opened, its contents—two cameras, a tensiometer, telemetering equipment, radar, a box of fruit flies—were intact. This was "Blossom I." For the first time, man had brought back a record of a rocket in flight made within the rocket itself.

The scientists then prepared to repeat the experiment, this time using a wedge-shaped quarter of the control section of a V-2 that will carry 200 pounds of gear including, in addition to the equipment of the first canister, pressure gauges, acceleration recorders and a complete data-recording unit that will operate while the rocket is in flight. There will be at least two such wedges sent up; one of aluminum, the other designed for special magnetic studies, made of wood. (Heat-sensitive paint on the outer side of the Blossom I canister *showed no signs of excessive temperatures* generated by skin friction.) Ultimately, although

Instrument-carrying canister is in two sections. In this view are seen camera (upper right) and parachute strap spool (center).

Other end of canister holds second camera (top), tensiometer (center), and wheat germ and fruit flies in glass flasks (bottom).



Drawing of a typical container indicates position of equipment and operating mechanisms.

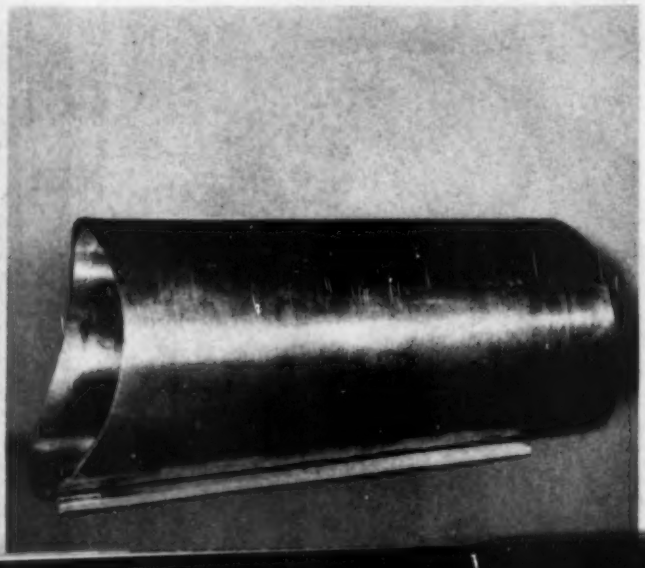
plans for future Blossom projects are iron-curtained by secrecy, it will probably be feasible and desirable to send up and bring back entire warheads containing a ton of equipment—a complete sky laboratory.

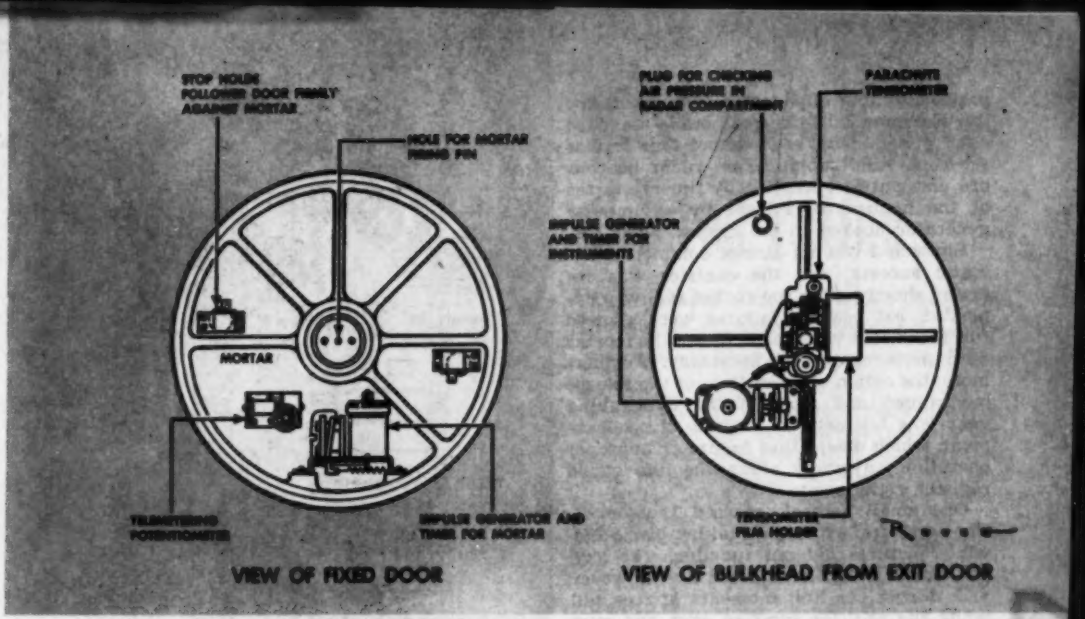
When that happens, sometime within the next two years, the dream of scientific conquest of the upper air will be a reality. It's the bringing back that is important.

Offhand, the problem seems simple to the layman, who recalls the old saying that "whatever goes up must come down." Actually, the matter is not quite so easy. As yet, no one can tell whether any specific rocket is going to soar 60 miles or fizzle out at six. This in itself poses serious questions of pressure and release time. For Blossom I the instrument case was pressurized and sealed at ground level (4,000 feet). In Blossom II, however, an installation of relief valves will permit a decrease from ground pressure to six lb. per square inch during upward flight and an increase from that to ground pressure during descent.

Release of data-bearing containers is more like a shotgun divorce than anything

On the way up, the canister rides in a hole drilled all the way through the V-2 warhead (photo at left, below). Carefully machined aluminum liner (right) holds canister in place until mortar automatically shoots it out for long trip back to earth.





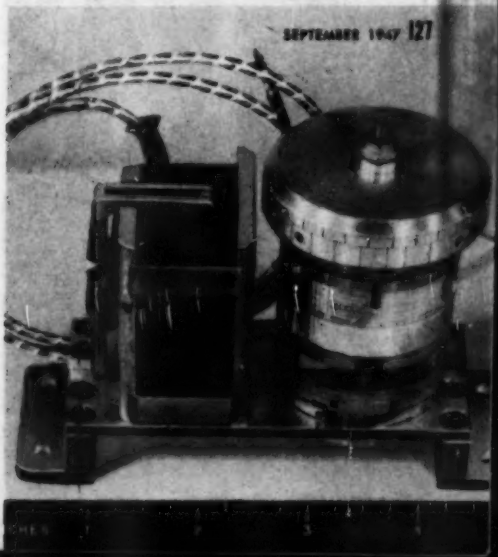
Fixed cover plate and the container's center bulkhead illustrate details of construction.

else. The container with the material to be returned to earth is ejected from the rocket by a small mortar charge (40 grains, or about 1/3 the charge of an 81-mm. mortar) that is fired by a clockwork fuse, similar in principle to the timers that set off anti-aircraft shells. The base of this mortar shell rests against a plate bolted flush with the outer skin of the warhead in Blossom I. In future projects it will rest against some other expendable part of the rocket.

The explosive thrust is exerted through a series of telescoped tubes against a plate behind which the pilot 'chute is packed. The pilot 'chute opens by mechanical drag as it clears the rocket, while the actual explosion sets off a timer—clockwork in Blossom I—which opens the main 'chute. A small bellows, operated explosively by the same sort of jack-in-the-box arrangement used to pull rip cords of cargo 'chutes, serves to clear the pilot 'chute from the main 'chute at the proper time. The strength of the original mortar blast, incidentally, may be estimated from the fact that the movable end of the canister is held

Operation of main 'chute release gear (solid cylinder, left) was telemetered to the ground by device in cup at right.

Mortar that kicks canister out is in small cylinder (right), with time fuse dials on top. Control (left) releases main 'chute.

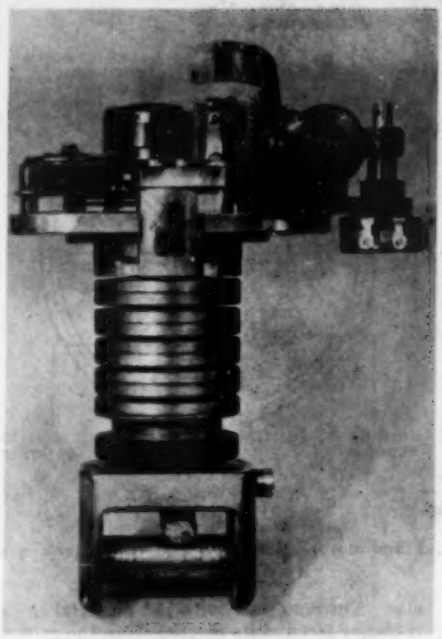


in place by four clips tested to break at 200 lb. Equipment like the cameras—standard AAF gun cameras set to shoot four frames a second—and subminiature radar beacons are also put in operation by timers started at the moment of release by an impulse generator hooked to the mortar firing pin.

Blossom I was an almost complete automatic success, and the canister was released shortly after the rocket fuel was expended, but possible failures were allowed for. Provisions were made to fire the mortar by remote control if necessary. Furthermore, the action of every item of the release mechanism and most of the data-taking gear was telemetered back to the release point, which meant that failure or improper operation anywhere along the line would register right away.

One small setback marred Blossom I. The earth-trained camera taking black-and-white pictures did not function. The sky-trained color camera worked fine, however, and, during the first moments of free fall, while the canister tumbled over and over, it got some earth pictures too. To the earthbound layman these last are naturally the most interesting, but to the scientists of Blossom project, whose eyes are fixed on greater and yet greater heights, they are trivial. Their interest lies in the operation of the ribbon 'chute—a solid 'chute would rip to tatters before it found dense enough air to open—and the safe return of information.

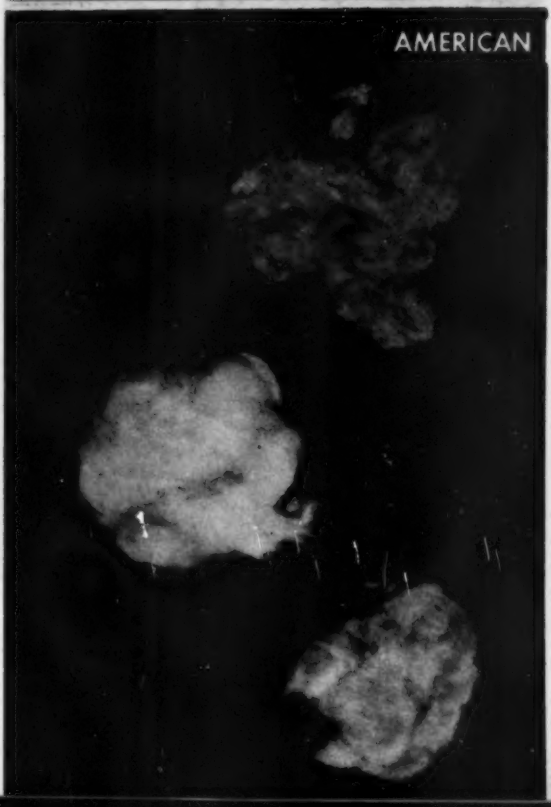
So far, more than a thousand people have volunteered to be shot skyward in a V-2. No one has taken these suicidal offers seriously because a lot of work and study remains before the dawn of the day of human rocket travel. Meanwhile, the Blossom project is one of the most important ways of hastening that dawn. END



Tensiometer measures parachute pull. Strap, fastened to bar (bottom), tugs on spring to drive film recorder's gears and needle.

This is how canister looks installed in V-2, but before attachment of the cover plate. Base of the mortar can be seen in center.

Close-up of parachute shows how ribbons are fixed to cords in pairs. This type of 'chute was a wartime German development.



U. S. Tests Russia's Colored Cotton

The natural-tinted varieties developed by Soviet experimenters don't fare so well when they are grown in Dixie.

THE growth of naturally colored cottons suitable for commercial manufacture, long a goal of agricultural experimenters, has taken its place among international rivalries—with Russian and U. S. experts in scientific competition.

In Russia, where extensive research is being carried on, the director of the All-Union Cotton Research Institute has stated that "experiments indicate natural colored cotton produces a greater length of better quality yarn to the mass of raw cotton," adding that blue, green, pink and smoke-colored shades are being developed. Brown fiber is also being tested, but requires the use of copper and chromium salts to prevent fading.

American agriculturists have experimented with green and brown cotton (PSM, Dec. '44, p. 102) but it proved poor for manufacturing purposes; the lints lacked luster and had a tendency to fade. Puzzled by Russian reports of success, U. S. experts tried to obtain samples of the Soviet seeds and of manufactured cloth. They did not get the cloth, but did get the seeds, which were planted last season at a few places in the South, including the U. S. Cotton Field Station, Stoneville, Miss.

The tests, however, indicated that the seeds grow one way in Russia and another way in Dixie. Of the eight stocks tested, six were Asiatic types, which have never done well in this country. The other two were New World types, but even the best—*Gossypium hirsutum*, the equivalent of our ordinary Upland type—did not match the performance of U. S. commercial varieties. So, even though some natural colored cotton is believed to have been used since Colonial times in home manufacture of clothes and household goods, the vision of a Dixie full of varicolored cotton fields remains a dream of the future.

The Kodachromes at the left illustrate some of the results obtained in the comparative plantings: Top one shows U. S.-grown cotton from the Russian-evolved seeds; the bottom one, cotton obtained from this country's Upland-type seeds.

How Navy Keeps Jets On the Job

A NAVY jet pilot who sees the insigne shown at the top of this page doesn't have to worry about the performance of his engine. It has been given the works at the Alameda (Calif.) Naval Air Station by highly skilled mechanics who know jet power plants from the ground up. They have taken the engine apart, piece by piece, adjusted alignments to a ten-thousandth of an inch, balanced the rotor so that it whirls with less vibration than that of a smoothly spinning top.

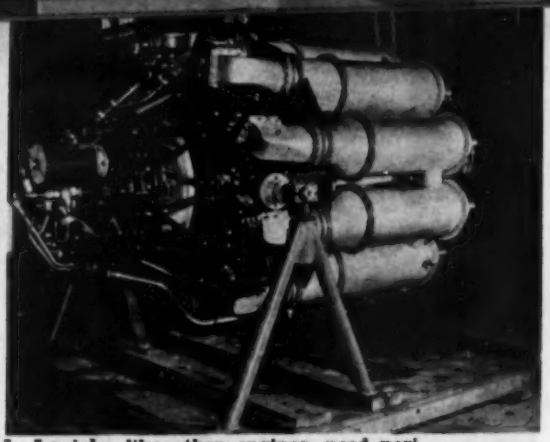
The rotor, heart of a jet engine and the mechanism that develops a jet fighter's tremendous thrust, strains every fiber of its alloy metal. Not only are the scooplike buckets of the rotor subjected to a continuous searing heat, but the tips whirl at a speed of 1,200 miles an hour, better than one-and-a-half times the speed of sound.

When the Alameda boys reassemble a rotor after overhaul, they know it is right —ready for another go at the grueling grind of jet flight.

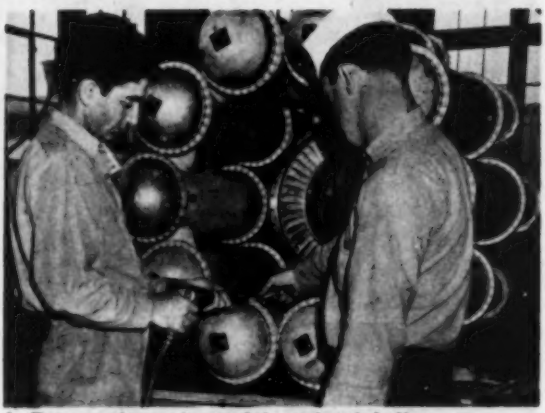
The all-important rotor, however, must have the proper co-operation of fuel pumps, fuel pressure control units, barometric valves, lubricating pumps, fuel spray nozzles, and the overspeed governor. Special flow and test benches do the job on these. One check even duplicates the effects of various altitudes in testing the barometric fuel valve.

If the strain on a part has been too much, the evidence will out when placed in a dark room and subjected to violet (black) light. The part under examination glows with a ghostly, greenish light, while the cracks or imperfections appear as black lines or splotches.

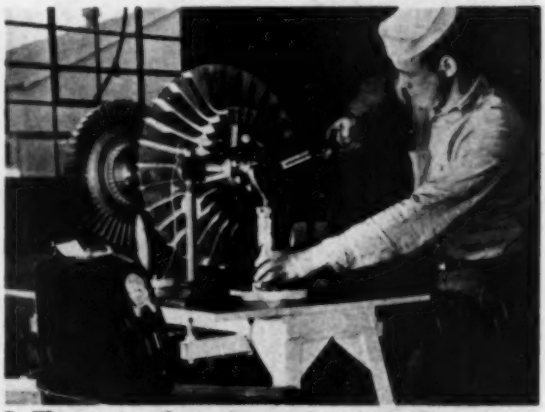
To keep Alameda's experts on their toes, weekly classes are held on jet history, theory, performance characteristics and the problems of high-speed flight.



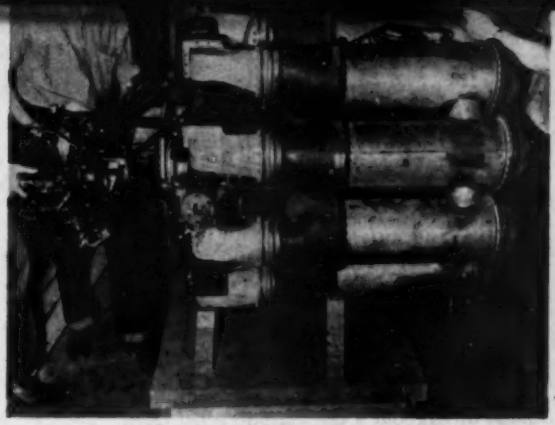
1. Jet jobs, like other engines, need periodic checks. Above, a GE I-16 is delivered at Alameda Naval Air Station for overhaul.



4. Power spinner is used to extract bolts, releasing combustion chamber domes. Rotor vanes are visible in the center.



7. The rotor, only major moving part of jet engine, is placed on a testing stand. Here the assembly shaft is being checked.

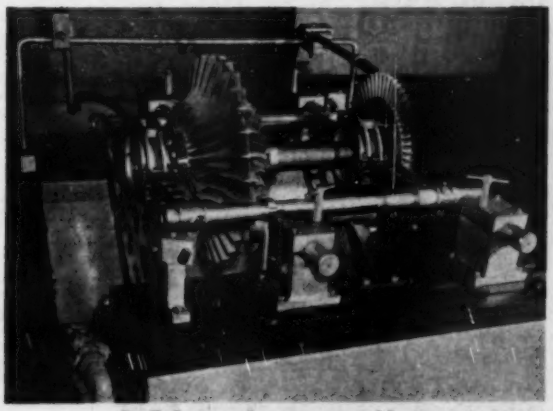


2. For first step in disassembly, engine is placed on horizontal stand and accessory case (left) removed before tear-down begins.

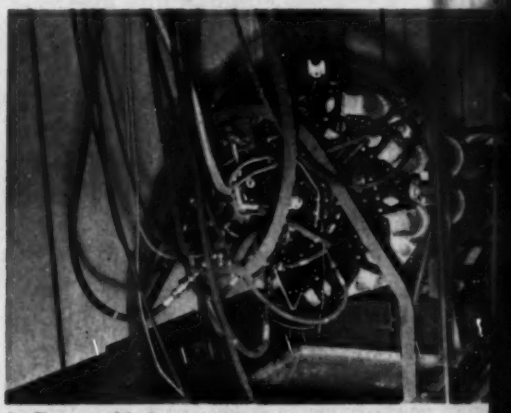
3. Engine shifted to vertical position, Navy mechanic removes the elbows. All types of Navy jet engines are handled at Alameda.

5. Assembly line in reverse moves along as the combustion chamber, ring, and elbow casing are removed from the turbine wheel.

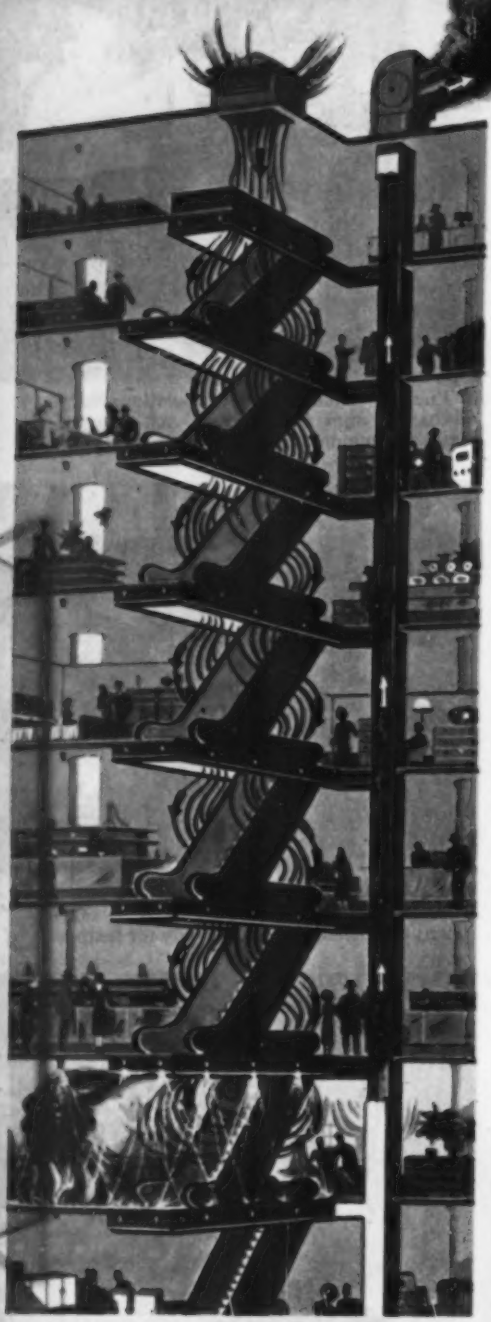
6. Compressor chamber is split and compressor removed. This is final step in tear-down; components are now ready for testing.



8. Balance of rotor assembly is under test. Rotor spins up to 16,000 r.p.m., and any unevenness could rip the engine to bits.



9. Reassembled engine, under power, gets final check. Run from adjoining room, jet blasts against deflector outside test cell.



In a typical department-store fire, illustrated above, exhaust-water-spray system prevents mushrooming of smoke and flame to the upper floors. Curtain of water keeps fire out of escalator well, while fan removes smoke and creates draft to pull fresh air down well.

These Stairs Block Fires

THE Number One fire problem—how to stop stairwells from sucking flames and smoke throughout a tall building—has been solved by a new system of exhaust ducts and water sprays. A test installation has kept upper floors and the vital exit stairway clear and cool while flames raged below.

Developed co-operatively by Otis Elevator Co., Westinghouse Electric Corp., and Grinnell Co., the exhaust-spray system is intended to protect department-store escalators.

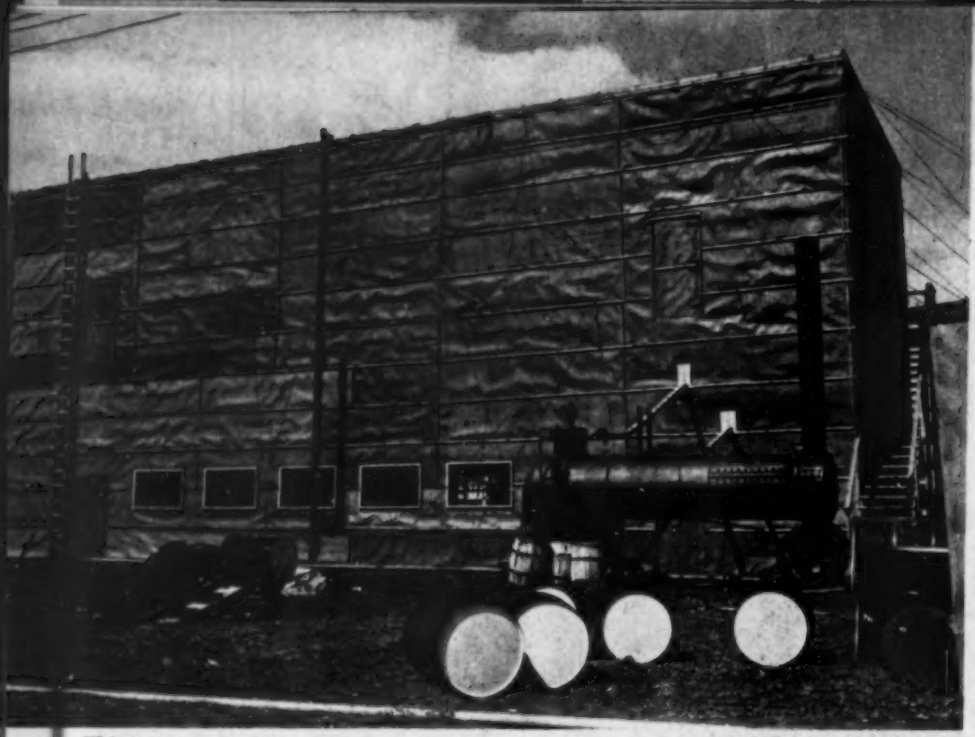
The installation automatically goes into action when a fire sets off any sprinkler in the building. It opens the dampers in an exhaust duct circling the escalator on the burning floor, starts a blower sucking smoke up through the duct, and opens a fresh-air intake over the escalator well.

The blower creates a vacuum in the escalator well, pulling fresh air from the roof intake down the well. This downward stream of air completely blocks the usual chimney action of a stairway and prevents upward spread of the fire. Should flame reach the escalator, nozzles opening automatically around the escalator curtain it with a sheet of water, while a separate nozzle inside the escalator well starts if any flame gets past the water curtain.

PSM photos by W. W. Morris and Robert F. Smith

J. Richard Hill, the Rhode Island deputy fire marshal, lights a pan of alcohol to create fire for demonstration of the new system.

In a vivid demonstration of the installation's effectiveness, a technician measures downward flow of air as flames roar below. Without this system, fire would envelop him.



This two-story building, largely tarpaper on a tubular steel framework, was erected for tests of the new system. It contains a mockup escalator fitted with exhaust ducts and sprinklers. Boiler at right furnishes heat in winter—when test fires are out.

Automatic control (arrow) works by water pressure when first sprinkler is set off. It sounds alarm, stops escalators and air conditioning, starts exhaust fan, and opens dampers in exhaust duct and air intake.

Technician examines damper in exhaust duct that circles escalator well. Through this duct smoke and fumes from fire are sucked outside building by fan, creating downward draft that blocks chimney effect of stairs.

Everybody has his own pet idea of some gadget he would like to see in general use. What is YOURS? *Popular Science Monthly* will pay five dollars for every such suggestion that its editors decide to publish. Suggestions cannot be acknowledged or returned.

I'd like to see them make

Cartoons by SYD LANDI

Roadside Phone Sockets. Connections along the road for portable, plug-in phones would let motorists make emergency calls, says E. Wasilewski, Orwigsburg, Pa.

Self-Stirring Pots. Spring-driven stirring arms that could be clamped to pots would be a boon to housewives, thinks Josephine Bourquin, of Conneaut, O.

Wind-Up Window Screens. Plastic screens that wind on rollers and pull up from the sill when the window is raised are the dream of Leighton Harris, Natick, Mass.

Waiter Catcher. To attract the waiter's wandering eye, E. V. Wilson, of Lexington, Ky., suggests table buttons that sound a buzzer and flash his section number.

Wrap-Around Warming Aid. For easier heat-treating of head, neck, arms and legs, Paul Carlstedt, of Edmonds, Wash., wants heating pads made in long strips.

Earphones for Pianos. Worn only by the player, they would save others' nerves while the children are practicing, claims E. Aileen Foster, of Albuquerque, N. M.

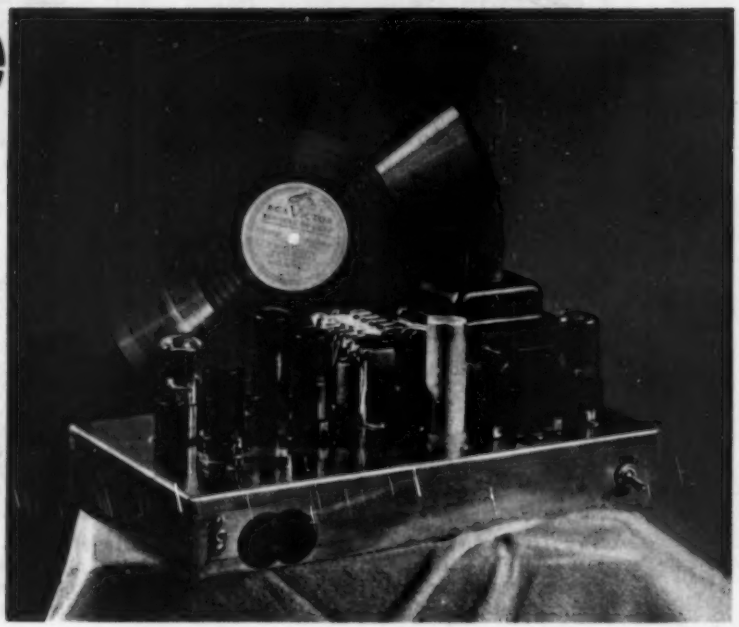
Copper By Candlelight. What material is more appropriate to these hand-fashioned candlesticks than the warm-hued metal that has been the craftsman's choice for centuries? Many find coppersmithing a source of fun and fascination even today. An article beginning on page 168 describes tools, working methods, and how to finish your handiwork either to a high luster (left above), or to an antique sheen as at right.

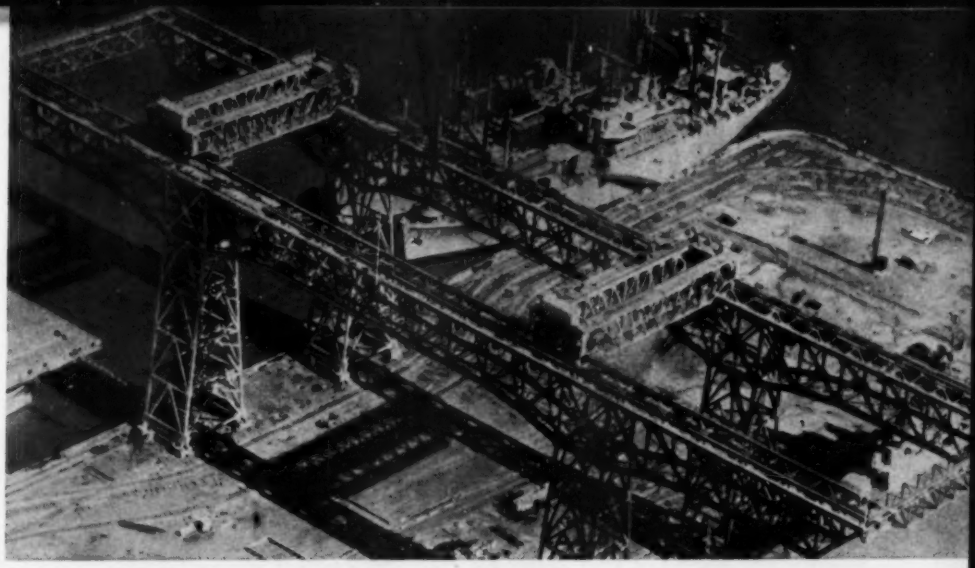
CRAFTWORK

PROJECTS OF THE MONTH

Phono Amplifier. There's more music on modern, high-fidelity records that meets most ears because only the finest phonographs are capable of reproducing a full frequency range. This amplifier, the second part of PSM's high-quality sound system, can help you get the musical richness that record makers put into their better disks. It's also a perfect companion for a radio tuner, microphone, or combination of any of these. Details start on page 202.

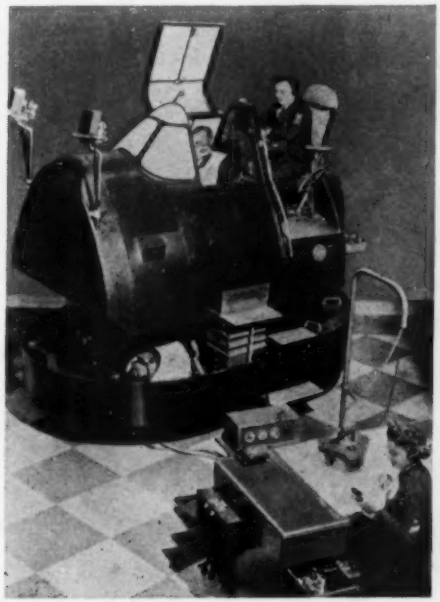
Photos by Hubert Luckett





Navy Raises the Limit

TOWERING 182 feet in the air and operating on a 730-foot overhead runway, this 450-ton crane is the largest in the world—by a 100-ton margin. It is being built by the U. S. Navy at San Francisco to speed repair of major fleet units.



Last Word in Illusion

CLOUD shadows over the cockpit, the roar of an engine, and the screech of tires during "landings" are only a few of the realistic touches in a new Navy instrument-flight trainer. A model of the Bearcat fighter, it even simulates rocket- and gunfire.

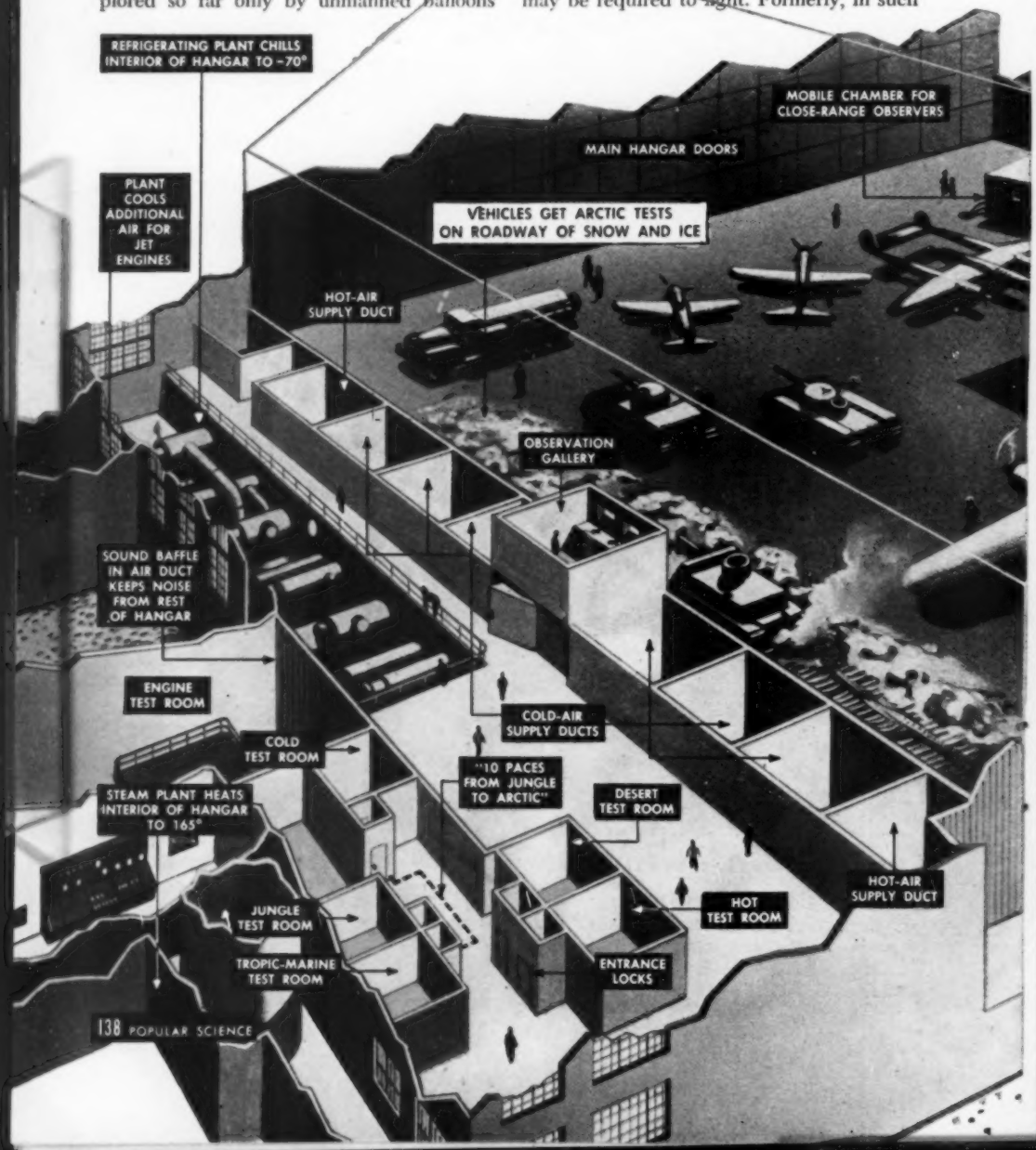
Outsize Kite Takes Off

KITE-FLYING contests, resumed in Japan after a 10-year suspension, brought out this 12- by 15-foot job, probably the biggest ever flown. Inset shows take-off of the bamboo-framed monster, which, with control ropes, weighed 1,430 pounds.

All the World's Weather

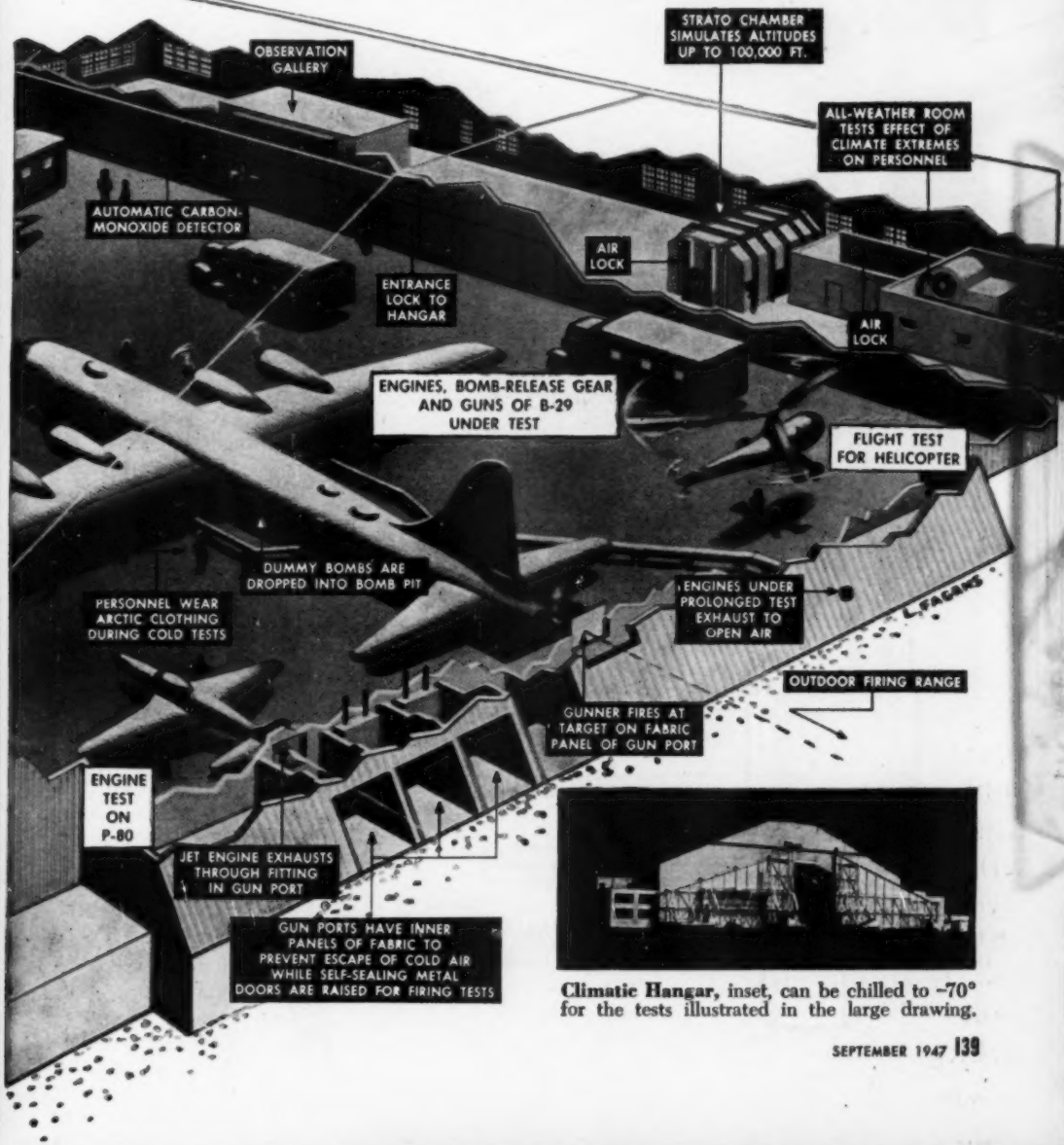
IT TAKES exactly 10 paces to travel from the jungle to the Arctic in the Army Air Forces' new Climatic Hangar at Eglin Field, Florida. A few steps more transport you to the dry heat of the Sahara, to the salt-laden sea air of New Guinea, or to regions explored so far only by unmanned balloons and rockets, 100,000 feet above the earth.

By providing all the world's weather under one roof, the Climatic Hangar enables the Air Proving Ground Command to determine the performance of men and machines anywhere upon the earth that they may be required to fight. Formerly, in such



Packed Under One Roof

elaborate and picturesquely named maneuvers as Operation Frigid, Operation Williwaw and Operation Furnace, expeditions have had to travel thousands of miles to try out Arctic and tropical gear—taking the fickle weather as they found it, or waiting another year. Now the Army's latest weapons and tactics can be tested, improved, retested and OK'd at the accelerating tempo that preparations for tomorrow's style of warfare demand. Heading the program are guided missiles, gun turrets, bomb-release gear, storage batteries and lubricants suited to the newly important polar regions,



Climatic Hangar, inset, can be chilled to -70° for the tests illustrated in the large drawing.

MOBILE WIND MACHINE CREATES 100-MILE-AN-HOUR GALE

POWER CABLES

NOZZLE FEEDS SAND INTO AIR BLAST

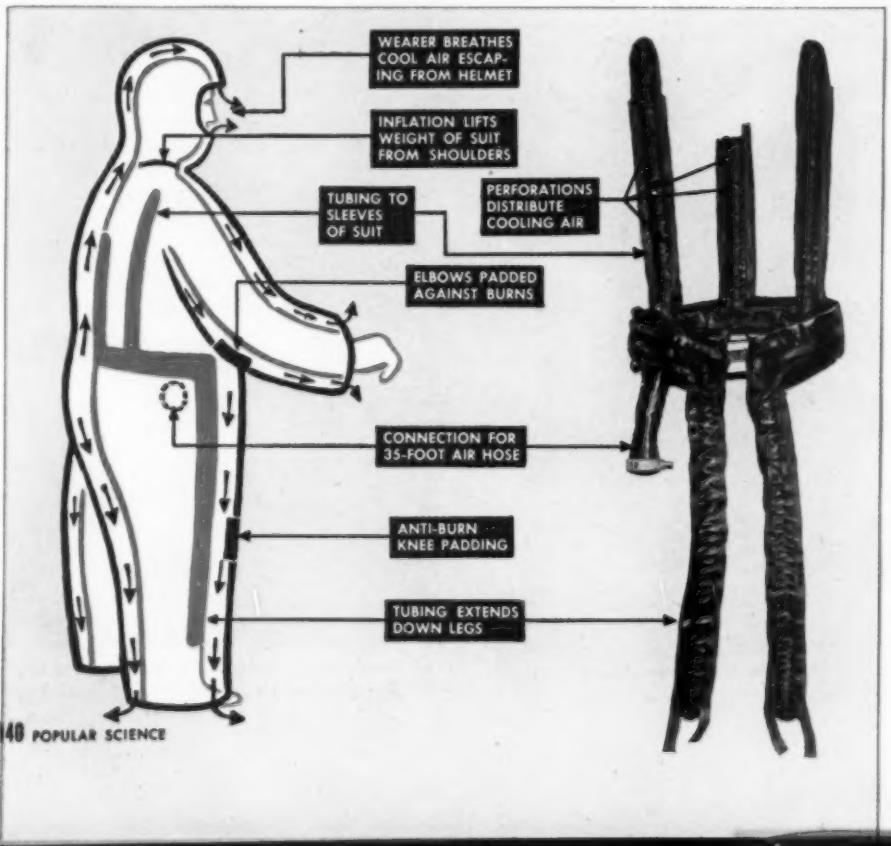
PLANE GETS TEST IN ARTIFICIAL "DESERT SANDSTORM"

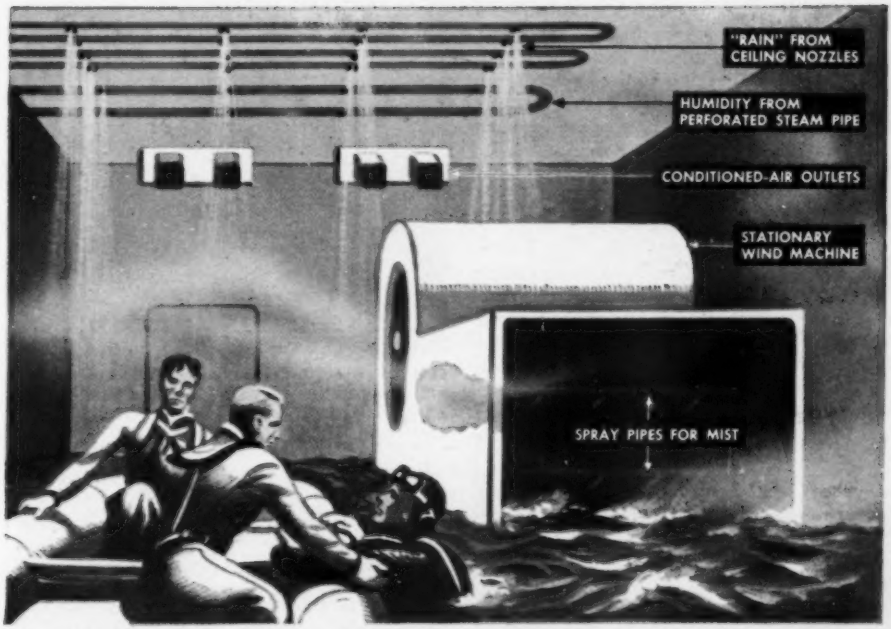
AIR INLET WITH 53-INCH FAN

"HOT SUITS" ENABLE MEN TO WORK IN TEMPERATURES ABOVE 100 DEGREES

DUCT SUPPLIES COOLING AIR TO MEN IN "HOT SUITS"

Equator's heat can be reproduced in hangar with temperatures up to 165°. Above, 100-mile-an-hour blast from mobile wind machine hurls a "desert sandstorm" at spinning propellers of P-82 under test. So men can work in heat, duct in foreground supplies cooling air to "hot suits," below, fitted with slide-fastened inserts of tubing that can be detached for cleaning.





All-weather room tests men and equipment in action under hot or cold blasts and artificial rain from overhead pipes. Stationary wind machine in background creates gale to which mist, sleet or snow can be added. Room can be flooded, as shown, to try out life-saving rafts and immersion suits that would be used by **fliers** forced down at sea and exposed to the elements.

and clothing and food packaging for all climates.

A hangar-shaped test room measuring 200 by 250 feet, with a ceiling up to 70 feet high, realizes the dream of the Air Proving Ground Command: an all-climate chamber large enough to hold the Army's biggest fighting machines in existence or on the drawing boards.

Chilling this enclosure of nearly 3,000,000 cubic feet to -70°, so cold that mercury thermometers have long since frozen solid and men in fur-lined Arctic suits can work only an hour and a half at a time, represents a feat unprecedented in the annals of air conditioning. The three-story, 9,000-hp. York Corporation refrigerating plant that does it, through ceiling air inlets and wall outlets, ranks as one of the engineering wonders of the world.

At the opposite end of the temperature scale, steam coils raise the hangar to the oven-like heat of 165°. It can be held at either temperature during tests lasting for weeks. A similarly conditioned engine test room accommodates the biggest aircraft power plants, while equipment for personnel and other non-bulky items may be exposed to made-to-order climate in an all-weather room, a strato chamber and five smaller, specialized testing cubicles kept permanently at climatic extremes.

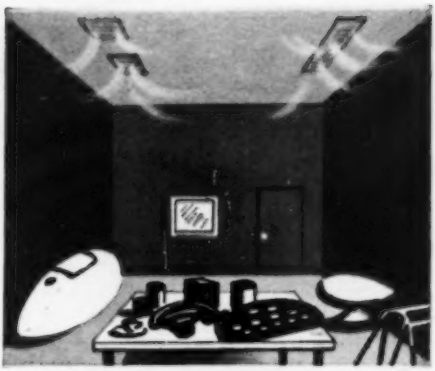
Artificial hurricanes, sandstorms or snowstorms are unleashed in the main hangar and engine test room by a mobile wind machine. Its 53-inch, 250-hp. fan creates a 100-mile-an-hour gale.

So that hangar workers can endure temperatures exceeding 100°, they wear "hot suits" through which a current of cooling air constantly flows from a U-shaped duct and 35-foot hoses supplying up to 20 men. The strange clothing may some day appear in combat, for trials suggest its use in tanks—and perhaps in future supersonic planes, whose cabins may be excessively heated by air friction at ultrahigh velocities.

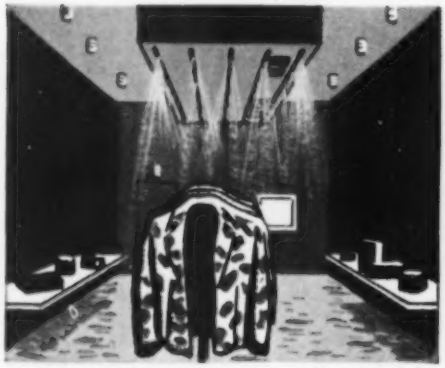
Even when the Climatic Hangar is sealed airtight, its vast size permits engines to be run and helicopters flown as in the open air. If carbon monoxide approaches the danger point, automatic detectors flash lights and ring alarm bells, warning that tests should be suspended until the ventilating system

flushes out the gas. For extended trials and tests on jet engines, special fittings discharge exhaust gas out of doors.

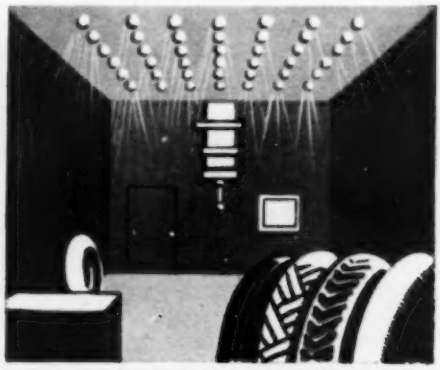
Closing the main doors of the hangar is an engineering feat in itself. First a built-in motor rolls each 200-ton door along railway tracks to a point at which T-shaped hooks along its upper edge engage wall cleats. Then motors retract the hooks, while other motors exert inward pressure along the bottom; under the combination of pull and push, the whole door moves six inches sidewise on rollers, to seal against top and side gaskets of rubber. Finally, cams depress a pivoted rubber gasket on the bottom edge of the door, completing the seal. Electric strip heaters around all hangar doors keep them from freezing shut. END



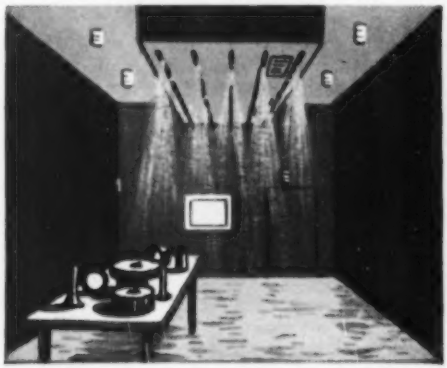
Hot test room provides temperature up to 165° and humidity as high as 95 percent for small-scale trials, as of plastic aircraft parts and food packaging for torrid climes.



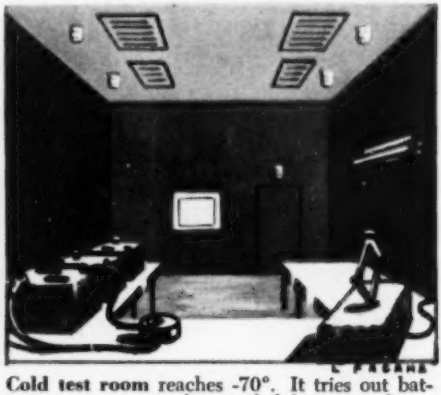
Jungle test room simulates actual day-and-night cycle of tropics' humid heat, with torrential "rainfall" from ceiling nozzles, to develop mold- and mildew-proof fabrics.



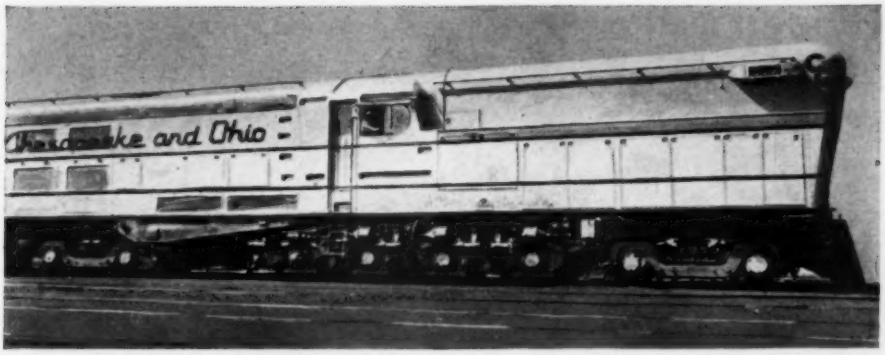
Desert test room employs 144 ultraviolet sun lamps in ceiling, providing equivalent of noonday sun over Sahara, to learn effect of dry heat on such items as rubber tires.



Tropic-marine test room adds salt spray to jungle climate for trials of ways to keep metal objects from corroding in climate like that found on tropical islands of Pacific.

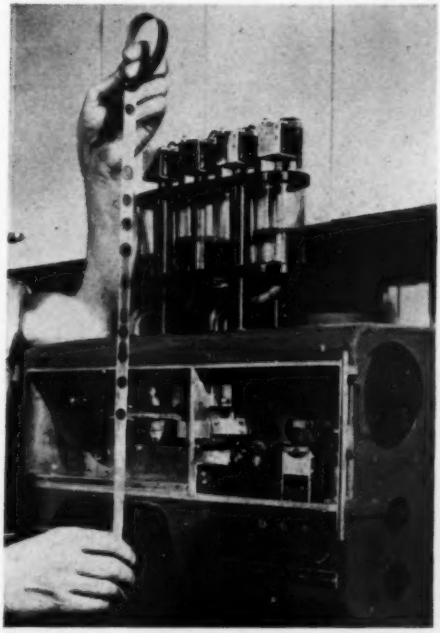


Cold test room reaches -70°. It tries out batteries, cameras, radios and lubricants, determines what effect long exposure to Arctic cold has on ammunition and rockets.



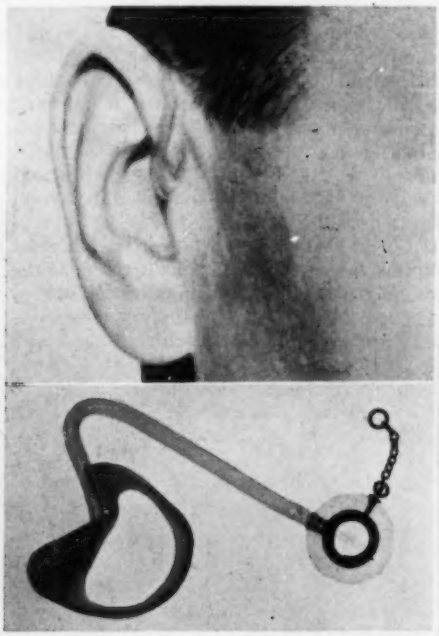
Biggest Ever Built

THE first steam turbine-electric locomotive ever built and the largest passenger hauler in the world, the Chesapeake and Ohio's No. 500 (above) starts service this fall. One of three coal-burning electrics being built for the line, No. 500 is more than 140 feet long, making it the biggest single-unit engine of any type. Its 6,000-hp. turbine, two generators and eight driving motors give it a top speed of 100 m.p.h.



Camera Speeds Testing

THIS machine will take a picture in a millionth of a second, automatically develop it in 25 seconds, then project it on a circular, built-in screen. A strip of exposed film is shown in front of the machine, which was developed by General Electric for testing electrical devices.



Hiding a Hearing Aid

ANOTHER step toward making hearing aids inconspicuous: A shell-like rim of flesh-colored plastic, a product of the Maico Co., of Minneapolis, fits into the ear and is hidden by its folds. A transparent lucite tube carries the sound from a tiny receiver, hidden under the hair or a collar.

Clever Farmer Makes Water Run His Pump

Harnesses sunken lake with handle a quarter of a mile long that never —well, hardly ever—stops working.

PAUL BUNYAN may never have visited the South, but down near Winston-Salem, N. C., there's a pump he should have seen. It has a handle a quarter of a mile long, and it makes water pump itself.

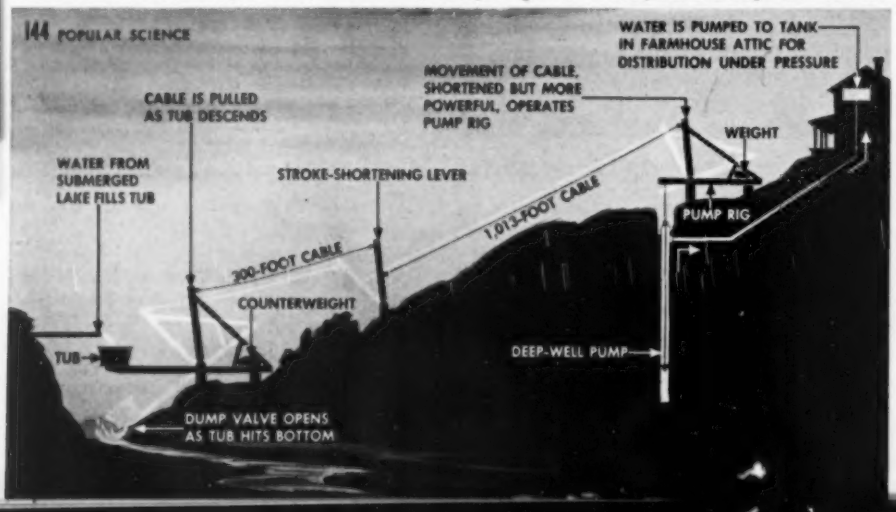
The pump was built by L. M. Craver, whose house is on a hilltop above a sunken lake. He got tired of lugging water and decided to make the lake do the work. Water from the lake flows through two pipes into a washtub on a weighted beam. When the tub fills, it thwacks down its end of the beam; a dump valve empties the tub and the beam rises again. From an upright atop the beam, a cable runs up hill to a lever that transmits a shorter, more powerful impulse along another, longer cable to a second weighted beam. As the tub goes endlessly up and down at the bottom of the hill, this second beam does too, operating a deep-well pump.

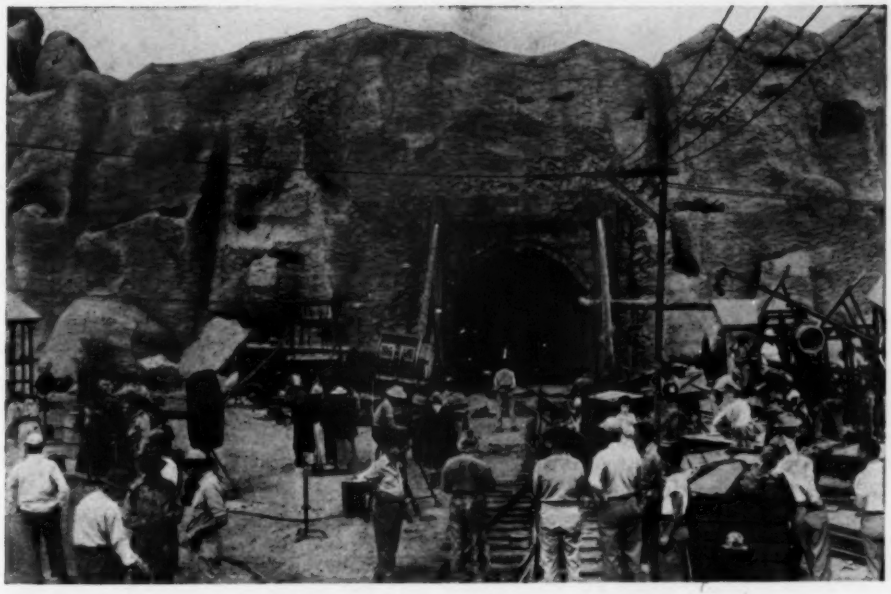
For 13 years, except when infrequent sleet storms ice up the homemade timbers, the pump has been filling a tank in the attic of the house for gravity distribution, with overflow pipes supplying a chicken house, a backyard drinking fountain and a horse trough. What's left over goes for irrigation, then runs back down to the lake to do some more work for Mr. Craver.

Pump rod, at extreme right, has only a short throw, but each upstroke sends a quart of water to tank, 400 feet away and 30 feet higher.

Washtub's dump valve is tripped at bottom of its fall. Runoff isn't wasted—it goes on to operate a waterwheel-powered machine shop.

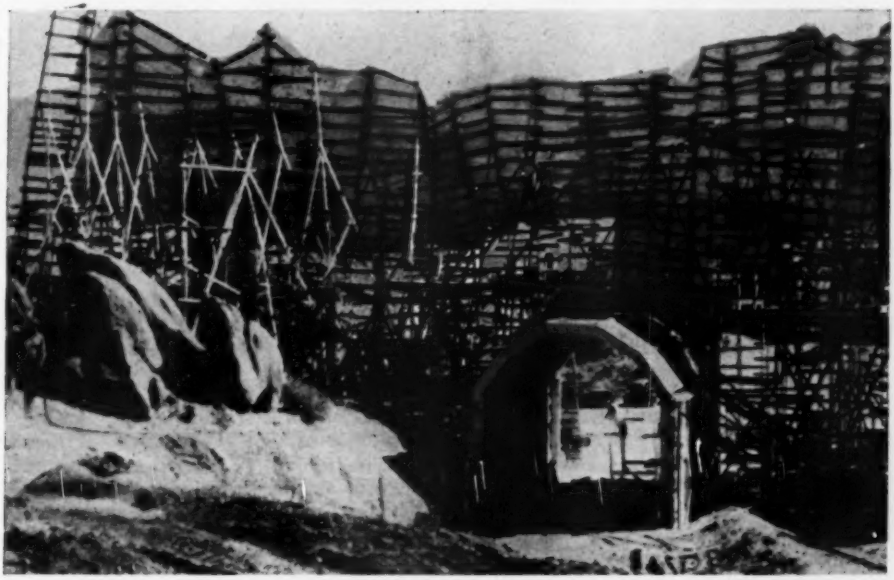
Sketch shows beginning (black) and end (white) of power stroke, made every two minutes.





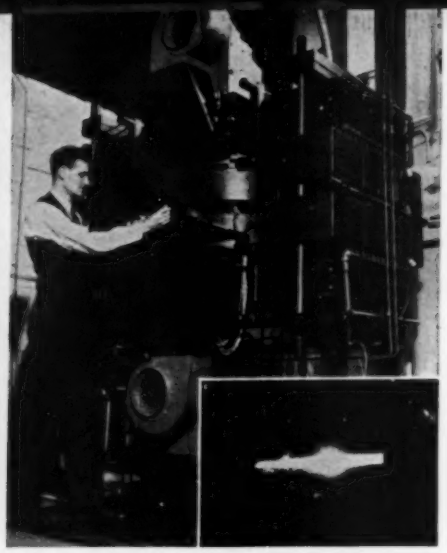
Mountain "Moved" to Camera

WHEN Hollywood wants an Andean mountain, like the one called for in the script of RKO's *Tycoon*, it's easier to build one than to go to the real thing. The rugged chunk of real estate shown above, complete to tunnel mouth and railroad tracks, was constructed in a ravine at Lone Pine, Calif., and to the camera it looks like the McCoy. But the movie camera doesn't go behind the scenes, as in the view below, where the cliff looks like what it is—a blend of wood, plaster and ingenuity.

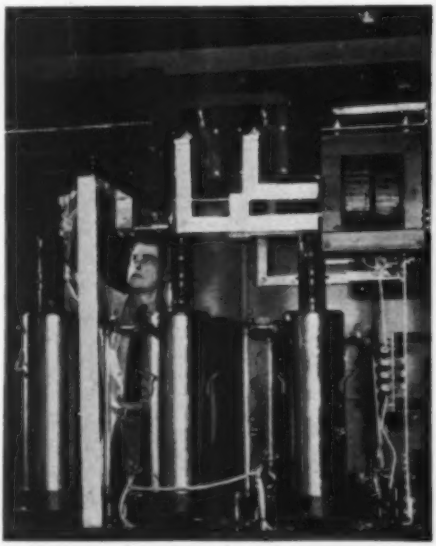


MARCH OF SCIENCE

Split Atom Photographed. A uranium atom was at the center of the white streak shown above; a neutron split it into two particles, which flew apart to form the line. Photo was made on Eastman's new nuclear-track plates, which are supersensitive to atomic electrical charges.



Electrons Light Own Path. Light from moving electrons is seen for first time in the 70-million-electron-volt GE synchrotron, shown above. The beam (inset) is emitted as electrons circle inside "doughnut," can only be seen head-on. Light spot in center is electron light; line is reflection.



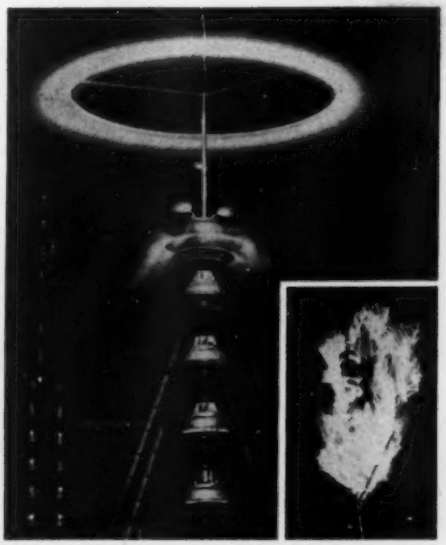
Tubes Guide Atom Smashers. These metal tubes are ignitrons, being assembled into controls for two new 300-million-electron-volt GE synchrotrons. Electronic switches, they control size and timing of current pulses in the magnets that hold electrons in orbit during speed-up.

Ray-Traps on Display. Westinghouse scientist holds a detector of radioactive atoms in liquids. Glass-tower counter at left of assortment on table does same in humans. In foreground is gamma-ray counter, plastic-masked against beta rays. Receiver at rear meters trapped rays.

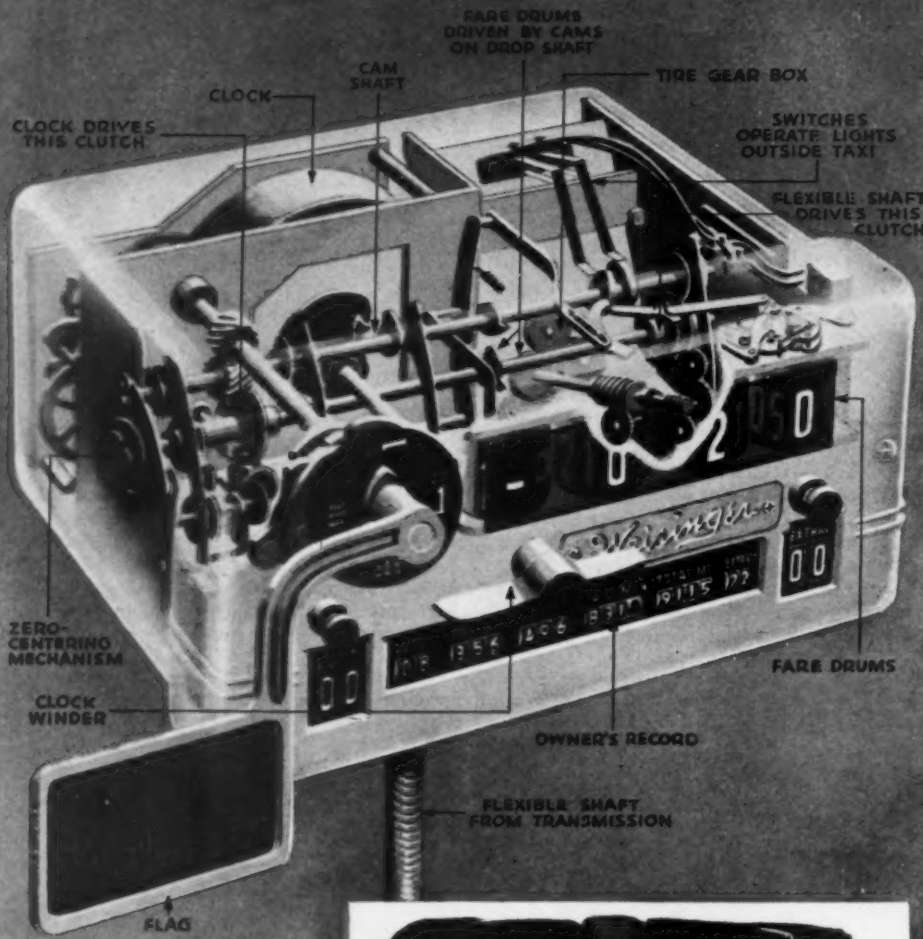
Hilltop Tower Relays Radio. This is one of seven Bell stations that relay microwaves between New York and Boston. Since the very short radio waves fly off into space, they must be beamed straight at next relay point. Four square metal "lenses" atop tower focus the microwaves.

Motors Hold Their Noses. This 2,300-hp. GE electric motor will be undamaged if waters close over it. One of six for Oregon paper mill flooded by 40-foot spring rises of Willamette River, its bearings and their pedestals are enclosed with stator and rotor in a watertight frame.

52-Ton Transformer. One of the largest electrical transformers in private industry is shown being installed in a new B. F. Goodrich plastics plant at Marietta, O. Nitrogen and 25 tons of oil insulate the 14-foot monster as it steps 132,000-volt AC down to 2,300 volts at 5,000 kw. output.



"Fireworks" Aid Lab Studies. Fiery pinwheel, a "corona motor," shows how high-voltage lines lose electricity through air. A million-volt charge spins rod like a water sprinkler. Torch (inset) is million volts crackling over insulators. Tests help Westinghouse design lightning guards.



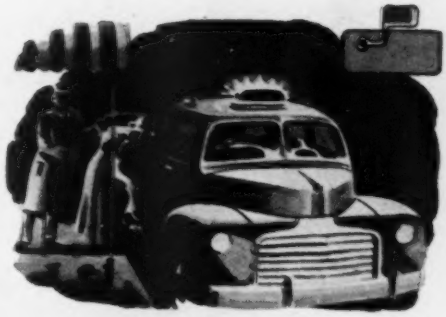
MECHANICS OF LIVING

The new Weisinger meter can go in the glove compartment or in the usual place on the cab partition.

Retrum

How the New Taximeter Works

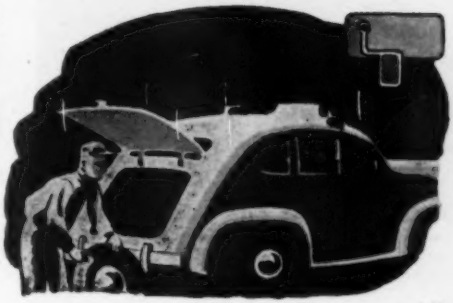
Night Light for Idle Cabs. The latest taximeters are streamlined like little radios—and their simplified construction cuts in half the usual 800 to 1,200 parts. The U. S. Taximeter Co., of New York, asserts that the Weisinger meter is the most important development in taximeters in 35 years. The new machine makes it easy to find a cab at night: Roof lights go on when the flag is in the upright, or vacant, position.

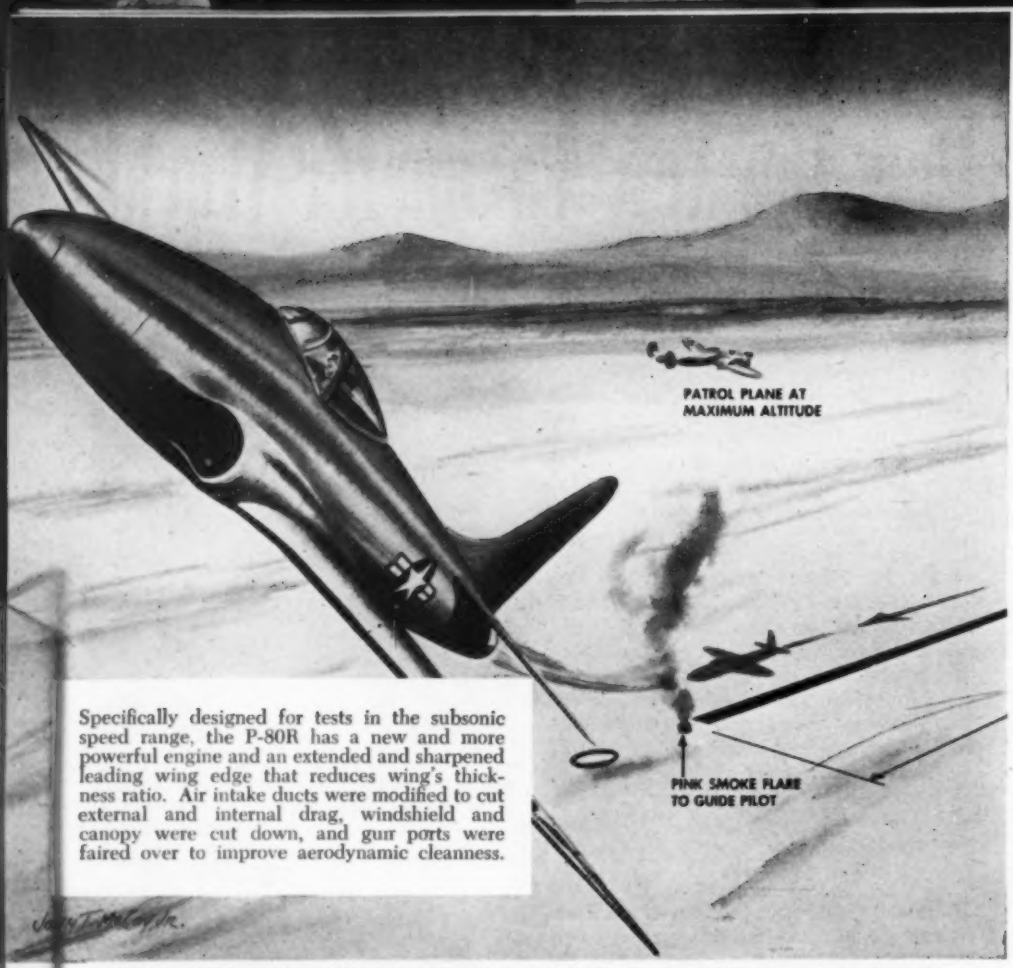


R.P.M.=888. Cutaway at the left shows the simplified mechanism. A flexible shaft connects the meter to the cab's transmission. Each revolution of the rear wheels is registered, and the meter can be adjusted for various tire sizes before it is installed. The tire gear box in the meter automatically compensates for tire wear or change in size. City authorities make both periodic and spot checks of the meter's accuracy. On test stands, meters are run up to $99 twice, at 450 m.p.h.

Minutes Mean Money, Too. When the taxi stops for a red light or travels at slow speed, a clutch allows the flexible shaft to slip. Waiting time is then registered in the fare section, at a preset rate per minute, by a hand-wound clock. Mileage and waiting-time charges are automatically totaled by the fare drums. Cams return all gears and drums to zero when the flag goes up at the end of the ride. The 85,000 taximeters in the United States last year ticked off more than $2,000,000,000.

Not Registering. If a tire blows out during the ride you will not be charged for the time required to fix it. The hackie swings the flag down, stopping the clock while you wait. Later, at the end of your trip, he lowers the flag again and the meter locks to give you time to read the total fare. The driver then unlocks the meter by pulling the flag slightly to the left before raising it. A fourth flag position is provided for "double tariff" in cities where such fares are authorized for unusual trips.





Specifically designed for tests in the subsonic speed range, the P-80R has a new and more powerful engine and an extended and sharpened leading wing edge that reduces wing's thickness ratio. Air intake ducts were modified to cut external and internal drag, windshield and canopy were cut down, and gun ports were faired over to improve aerodynamic cleanness.

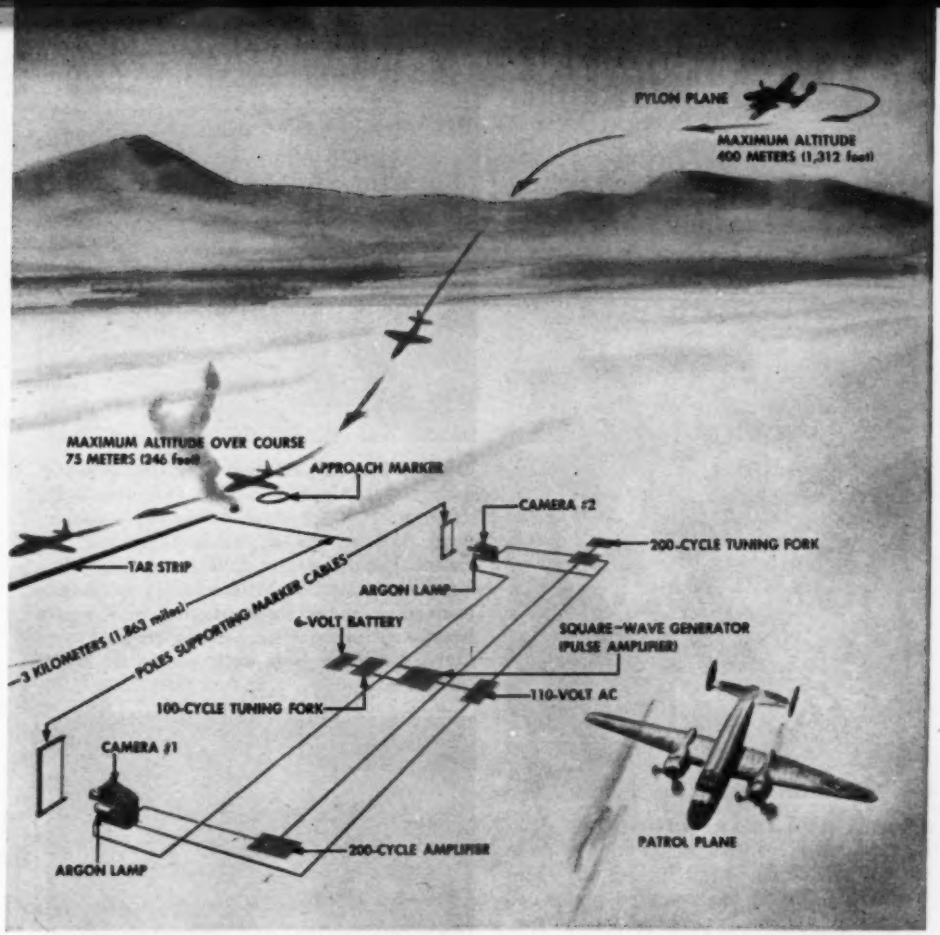
Artist's conception of conditions under which P-80R, nicknamed "Racey," set speed-mark.

Cockpit view of Col. Albert Boyd, the new speed champ. His plane has a GE-designed Allison 400 jet, rated at 7,500 hp. at 600 m.p.h.

Souped-Up P-80 Double-Checked On Record Run

WHEN a super P-80 flashed over Muroc Dry Lake last June 19 at an average speed of 623.8 m.p.h., electronics and high-speed photography teamed up to make doubly sure that the AAF's new world air speed record became official.

The primary timing system, so accurate



Making four passes "on the deck," at 50-foot altitude, plane flew one run at 632.5 m.p.h.

that it determined the plane's position to within three inches, depended upon the "heartbeat" of a 100-cycle tuning fork. Impulses from this fork, amplified through a square-wave generator, operated argon lamps to flash a synchronized series of light impressions on the edges of motion-picture film racing through twin cameras at 500 frames a second. One camera "shot" the plane during the first half of each of its runs, and the other pictured the second half; light impressions linked the two films in a complete record.

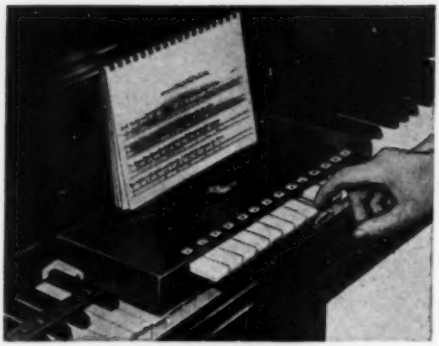
A secondary timing system was provided by clocks mounted in the base of the cameras and synchronized by the pulses of a 200-cycle tuning fork. Showing intervals of 1/1,000 second, the clock faces were photographed every time a frame of the motion-picture film was exposed. END

One of twin cameras, its lens exactly centered on a vertical marker cable accurate to 20 seconds of arc, perches on a special concrete base.

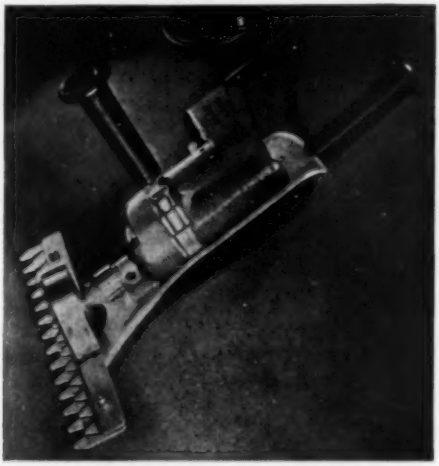
AIDS TO MODERN LIVING

Cleats Are Detachable. Any shoes become golf shoes with the addition of these cleat-studded sole plates. Fitting any shoes from size 7 to 12, the rustproof plates can be quickly put on or removed by the turn of a key. They are made by the ParCleat Company, of Washington, D. C., and sell for less than $3.

Corn Clippers Cut Kernels. Whole kernels are sheared off for canning by four semicircular knives in this tubular device. Guides gliding over the tops of the kernels adjust the cut as the ear is pushed through. The manufacturer is the Jiffy Products Company, of Hiawatha, Kans.

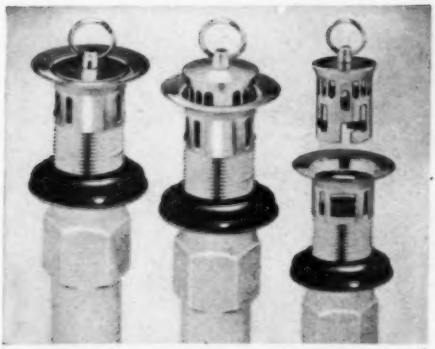


One Finger Plays Piano. An attachment that can be used on any piano will strike a chord of three keys each time a single key on the device is depressed. It enables the one-finger virtuoso to play without long practice. No musical knowledge is needed; notes are translated into numbered keys in an accompanying book. Ayer, Davis & Co., of New York, makes it.



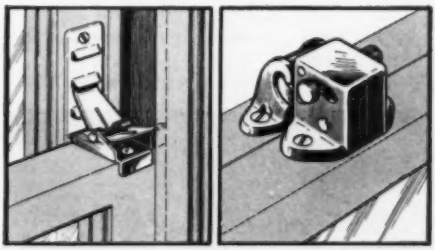
Drill Runs Hedge Trimmer. Fast hedge clipping and shrub pruning are possible with this 3¾-lb. cutter fastened by one bolt to an ordinary ¼" electric drill. Trimit, as the attachment is called, is made by the Woodland Products Company, of Pittsburgh. It is priced at about $15.

Soaking Cleans Paintbrush. A liquid put out by the Savogran Company, of Boston, makes old brushes usable if soaked overnight. It costs $1 a quart.



Modernizing Washbasin. A pop-up drain that operates like the modern built-in type is now available for installation in old plumbing. No special tools are required. At left the stopper is shown closed, at center open, and at right removed by a twist for cleaning. The drain is all metal—chromium-plated brass. It is made by the Stellar Products Co., of Chicago.

Wash Done in a Shaker. Socks, stockings, and shorts can be washed in a hotel or bathroom with the large-size plastic swirl mixer shown at right above. The others in the photo are one- and two-cup sizes for mixing gravy, sauce, waffle batter, salad dressing, and cocktails, also by swirling. The manufacturer is the Rochow Swirl Mixer Company, of Rochester, N. Y.



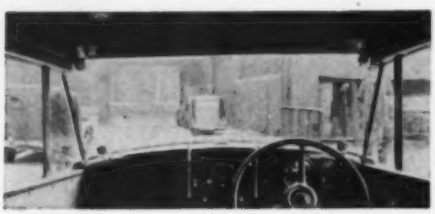
Windows Lock Automatically. Two new latches for double-hung windows are safety devices that lock themselves when the window is closed. At left, the lock of the Perfect Manufacturing Co., of Seattle, has the additional feature of locking a window against prowlers while still providing up to 5″ ventilation. The lock shown at the right, made by the New Products Co., of New York, has a spring bolt operating like those of spring door locks. Either may be released easily from inside.

Electricity Plays Accordion. Somewhat larger than the standard instrument, a piano accordion invented by Louis De Fonso plugs in on either AC or DC. It has the regulation button arrangement for left hand and piano keyboard for right, and is portable despite its size. The Accordionola Mfg. Co., of Chicago, makes it.

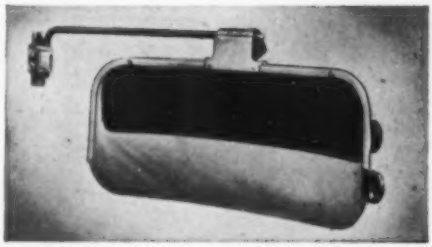
Fluorescent Trouble Light. With a 25′ rubber-covered cord, a fluorescent lamp made by Sylvania is handy for lighting dark corners in attics, cellars, shops, and garages. It uses a 6-watt tube mounted in a reflector guard so small that it will go through an opening 2″ square. A ballast is located in the line 3′ from the plug, whereas starting and off buttons are on the reflector. The lamp has a hook on the end and provision for mounting as a permanent bench or wall fixture. About $8.50.

Sport Smokers. Ash trays installed on stands in the shape of familiar pieces of athletic equipment are a new accessory on the market for sport lovers. Now available are "sport model" smoking stands designed in the form of tennis rackets, golf clubs, and bowling pins. They are being offered by the Funderburk Engineering Company, of Waltham, Mass., for use in playrooms, studies, and the like.

AUTO IDEAS

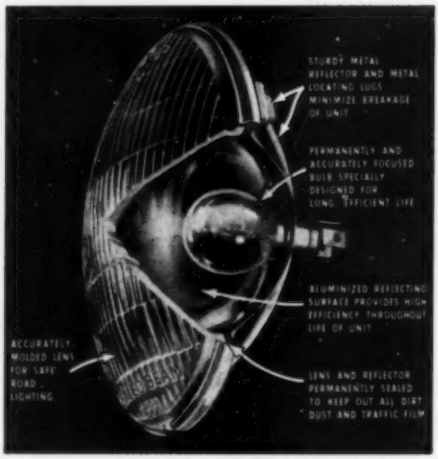


Windshield Posts Narrowed. Fuller vision is provided the driver by cutting to a minimum the thickness of the windshield posts on this English station wagon. The body is built by Queensway Motors, of London, and is fitted on a Ford chassis. It's said no loss of structural strength results, as the car top is fully supported by other body posts.



Visor Is Cross-Polarized. This sun shield for buses and trucks employs a polarized film between clear plastic sheets to furnish glare-free vision. An attached smaller visor has its polarized axis at right angles to the first and can be brought into use to control brightness when driving into the sun. Samuel Moore & Company, of Kent, Ohio, is the distributor.

Covers Fit All Seats. Three styles of a new one-piece slip cover care for all standard automobile seats. The fabric stretches to size and shape as it is pulled on and is held snug by a drawstring in the hem. A product of the makers of furniture slip covers, Kwik-Fit car-seat covers sell for less than $5 a unit.

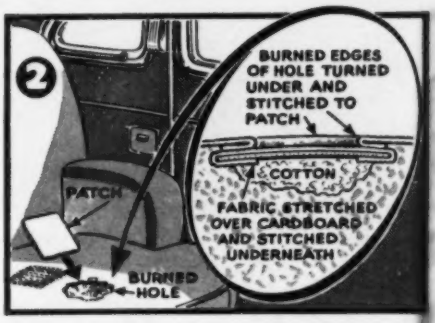


Sealed Beam Stays Lit. Unlike the filament in vacuum-type sealed-beam headlights, a separate bulb in this unit remains operative when the lens is cracked and provides illumination until the damage can be repaired. The light shown is made by the Guide Lamp Division of General Motors Corporation. Several other companies make them on the same principle.

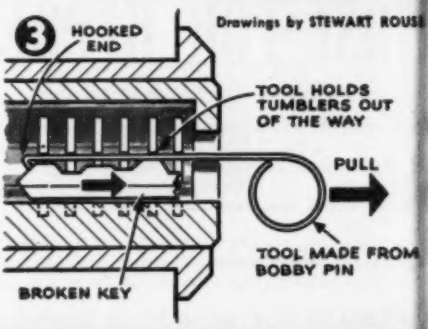
AUTO HINTS

1 *Boxes Hold Garage Shelf.* A sturdy shelf may be quickly put up in the garage by nailing two boxes of equal size to the wall and then nailing a wide board across them. The boxes themselves also provide storage space.—W. H. McClay.

2 *How to Patch Upholstery.* To repair small holes in car upholstery, cut a piece of matching material about twice the size of the hole, place this over a piece of cardboard ½" larger than the hole, turn under the edges, and sew or cement them fast. If the inside padding of the cushion has been damaged, fill the cavity with cotton. Then work the patch into the hole, turn the edges of the burned area under, and stitch to the patch to give a snug fit.

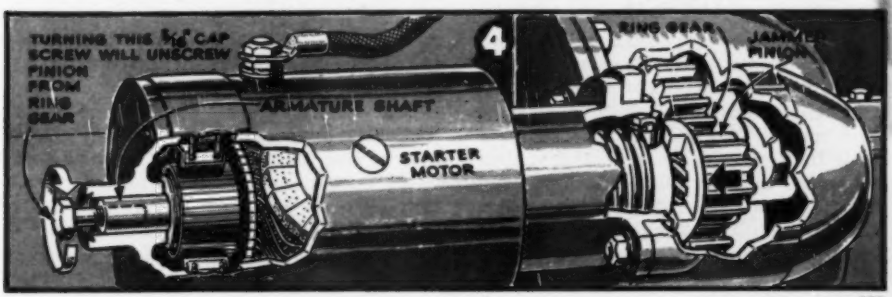


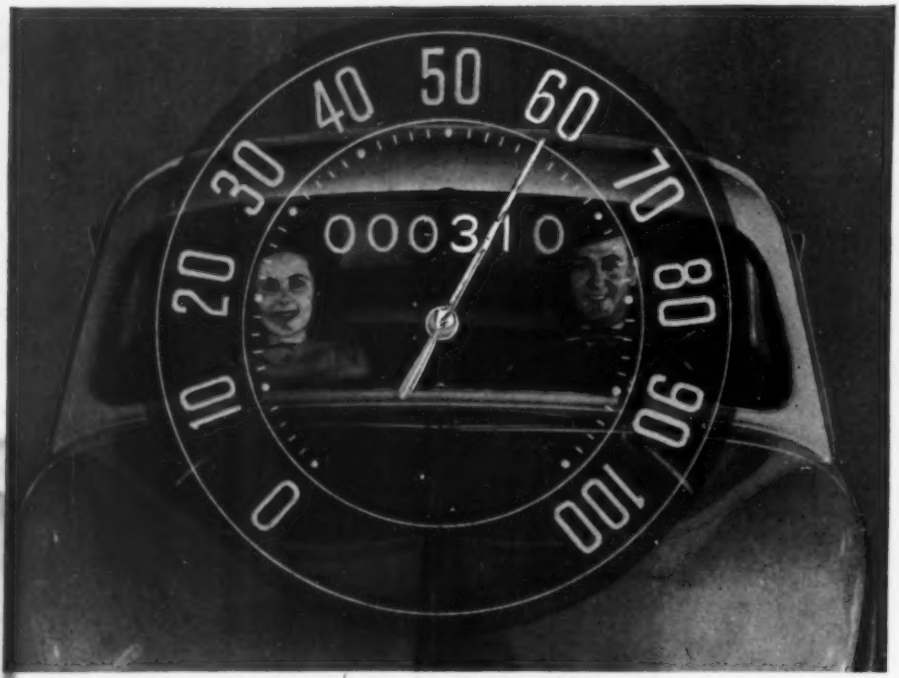
3 *Pin Removes Broken Key.* A bobby pin, straightened and then bent to give it a small hook on the end, can be used to pull a broken key from a car lock. The pin holds the tumblers out of the way, letting the key be withdrawn.—S. Wooler.



Drawings by STEWART ROUSE

4 *Screw Unlocks Starter.* If a starter has a habit of jamming, a 5/16" cap screw placed permanently in a hole drilled and tapped in the end of the armature shaft will enable you to loosen the jam quickly. In a starter of the type illustrated, turning the screw clockwise will pull the jammed pinion free from the ring gear. Remove the starting motor to drill the hole. It will also be necessary to drill a clearance hole in the dust cap.—N. W. Goodwin.





Driving at 60 with only a few miles "on the clock" isn't as harmful for a brand-new car as it once was.

Must You Break In a New Car?

Fast speeds at lower mileages are now all right, but the answer still is "yes" if you want the best ultimate results.

By R. P. Stevenson

BREAKING in a car no longer demands the crawling speeds of a decade ago. Improvements in design and manufacture, and in lubricants, have contributed to outmoding the old, slow break-in process. Since the war, virtually all manufacturers have issued revised recommendations for operation of their cars during the first few thousand miles, most of them now approving faster speeds at lower mileages. Going even farther, several have dropped the subject of break-in entirely from the instruction booklet they furnish with a new car.

Consequently, you may hear it said that a break-in period no longer is necessary. If you do, it would be well to raise a skeptical eyebrow—particularly if you are interested in getting the most from the investment a new car represents.

The fact is that, although you may safely drive fast sooner, you still are dealing with a piece of machinery that is not yet capable of its ultimate performance at the time it reaches you, however perfect it may seem in comparison with the standards of some years ago.

A new car these days has many so-called frictionless bearings (that is, ball and roller), but it also has many friction-producing metal-to-metal movements – rotating contacts, as in the crankshaft and wristpin bearings; and sliding contacts, as in the cylinders and rings. On how these surfaces wear in, a great deal depends—including the eventual

power of the engine, its silence or noisiness, and its oil economy.

As any machinist knows, a properly sized bearing at first is a bare running fit, with a tendency to be stiff, to run hot, and to seize or score if not babied. As it runs, the exceedingly small (millionths of an inch) protuberances on the facing surfaces are worn away, leaving a bearing that is free running but in no way loose.

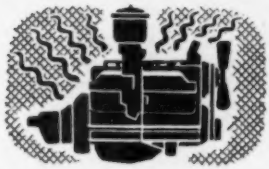
Improvements in the finish of mating parts are given a big share of the credit for cutting down run-in time. By modern techniques, they are sized within a few ten-thousandths of an inch and given a smoothness of millionths of an inch. As a result, they are ready for their best work sooner.

In the field of metal finishing, a process that is a comparative newcomer has been assuming a position of increasing importance. This is honing, a method by which a bonded abrasive is worked over an area. If the customary finishing methods were to be ranked in an ascending order of nicety, honing should be given a place above the other three—machining, which at best gives a comparatively rough surface; grinding, always useful but by no means perfect; and lapping, which has production disadvantages.

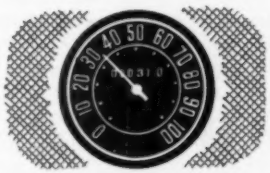
Honing finds perhaps its greatest usefulness in the finishing of cylinder bores, but it also now helps give an ultrafinish to many other auto parts. A great increase in mileage between ring jobs in the last two decades may be traced mainly to this process. Without enlarging the diameter of the bore to any extent, honing knocks down the peaks

Watch These Points During the Break-In

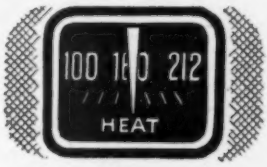
LUBRICATION. Metal-to-metal contacts need plenty of oil while wearing in. So check the oil often.



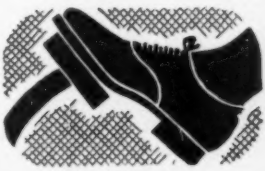
ENGINE HEAT. Allowing a new engine to overheat is an invitation to all kinds of expensive repairs.



WATCH SPEED. Gradually push the car up to higher road speeds. Crawling along won't break it in.



WARM UP FIRST. Allow the engine to run a bit before driving so the oil will be warm and flowing.



BABY THE BRAKES. Go easy on the brakes for a few hundred miles until the linings are broken in.

SERVICE CHECKUP. Most new-car service policies entitle you to these. Don't fail to have them.

and jagged tips of surface irregularities that are apt to wear out the rings.

Until a bearing has run in, it will operate at a higher temperature than ordinarily. For that reason proper lubrication is never more important than during the break-in period, if scoring or seizing are to be prevented. Motor oil has a dual function—to cool the moving parts and to reduce friction. New processes by which protective metal platings are applied to bearing surfaces in some new cars offer a safeguard against temporary oil starvation.

Always Warm Up the Engine

Temperature is an all-important tipoff while an engine is new. Like the temperature of your own body, the engine temperature quickly reflects any abnormal condition. Never allow a tight engine to run too hot. If you do, your nose probably will let you know, since an engine running on the hot side has a distinctive smell—a hot metal and varnish odor. So keep an eye on the heat indicator—after the engine has had time to warm up.

Proper warmup is essential whether an engine is old or new. Engineers have found that the greatest amount of damage occurs during the first three or four miles of driving, when the lubricants have not yet thinned out sufficiently to coat all the moving parts. Before leaving the garage, let the engine idle for about five minutes. If you must set out immediately, drive slowly for the first dozen miles or so.

During the break-in period, some new cars may require what appears to be an unusual amount of oil. This should cause no worry. Until the piston rings are properly seated, oil may get past the rings and into the combustion chamber. This often is helpful, for the extra lubrication allows the rings and pistons to wear more gradually and form a good seal. After the car has been driven 2,000 or 3,000 miles, the oil consumption should drop to normal.

Faster Speeds Make Better Cars

A memorandum distributed by Plymouth to its dealers explains that some new owners who report using more oil than expected may be keeping the oil level at the "full" mark rather than the "running level" mark on the dip stick. When the level is too high, the excess is vaporized and escapes through the crankcase ventilator. Plymouth advises that in checking the oil when the engine is warm the level should be kept up to but not above the "running level" mark.

When many new cars are delivered, the crankcase oil is S.A.E. 10-W, no matter what the season. This should remain in until the first checkup—at 1,000 miles, or whatever your service policy stipulates. If oil must be added before then, the manufacturer usually recommends use of the same grade. A careful owner will of course not neglect to take in his car for these checkups.

There is now a fairly general feeling among automotive engineers that faster break-in speeds produce a better final result. The slow speeds of the past sometimes failed to accomplish the purpose for which they were intended. Although the driver may have complied with all instructions, his car would sometimes not be broken in by the time the specified mileage figure had been reached. Consequently, when the driver speeded up, thinking it was safe to do so, the bearings often were scored or other damage caused.

One prominent Detroit engineer believes that limited break-in speeds are not needed by a man with good engine sense—an expert who knows and understands his car and can make it a part of himself. Such a driver can feel when a new car is tightening up and not responding as it should. When that occurs, he will ease off to a slower rate. Unfortunately, not all drivers can classify as expert.

Break In the Brakes Too

One rule on which there is agreement is that a new car should never be held at any speed the first time it is pushed to that figure. For example, the first time you reach 50 m.p.h., keep the car there only a brief time before dropping back. Then, after it has been raised to 50 on several occasions, push it to another slightly higher point. Keep repeating this procedure until you have reached the peak performance of the car. If a car never has been driven over 40, don't raise it suddenly to 70 or 80. Work it up gradually.

In addition to the engine components, the rear axle, gears, and brakes also require time and use to wear in properly. Rear ends used to be especially subject to damage, but the high-pressure hypoid lubricants now used in many cars help reduce this. In the case of the brakes, fast stops should be avoided for the first few hundred miles until the linings acquire a smooth finish. END

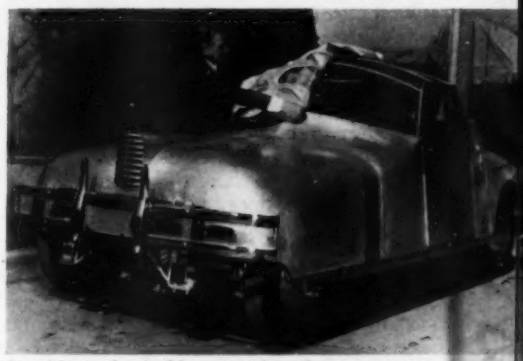
Sheet-aluminum on 1" chrome-molybdenum steel tubing forms a light body for this home-for-two on wheels.

Rear-Engine Car Boasts Kitchen

WHEN Roy Hunt, Hollywood cameraman, decided stock automobiles weren't ideal for camping, he rolled out his own. Except for a four-cylinder, 90-hp. air-cooled Franklin engine from a war-surplus plane, and a Ford Model-A transmission, Hunt built the car from stock materials. He mounted the engine in back, placed a kitchen and dining equipment under the front hood, and made seats convertible into beds.

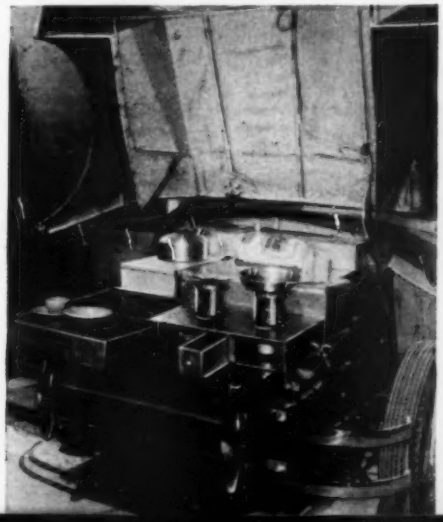
Motor and transmission are suspended by a ball-and-socket joint in front and hinged to the rear axle; there is no universal joint or drive shaft. Undoing two clips and one bolt permits rolling out the power unit.

Flat doors only 1" thick increase the inside width of the sheet-aluminum body. The car is 4' 8" high, 16' long on a 114" wheelbase, and weighs 2,045 lb.



Roy Hunt, the builder, stretches the canvas top over the frame. Vents are provided at the sides and back of the rear-engine compartment.

Hidden under the front hood is a complete kitchen and dinette, including icebox, sink, GI gasoline stove, folding table, and dishes.



Gail Davis rests on a full-length bed while Regan Callais, another movie starlet, is at the wheel. A second bed extends from the driver's seat.

Gus Comes Home to Trouble

By Martin Bunn

GUS WILSON was in such a hurry to get back to the Model Garage that, instead of waiting five minutes for the bus that passes it, he took a taxi from the railroad station.

He had had a grand time visiting his sister out in Colorado, but now that he was almost home, the two weeks he had been away seemed like two years. In the course of the 10-minute ride, so many misgivings about what might have gone wrong in his absence chased each other through his mind that he was almost surprised to see the familiar garage still standing.

His partner, Joe Clark, grinned a welcome from the office door, and Stan Hicks, the grease monkey, leaning against the gas pump as he slow-motioned through his morning chore of hosing off the concrete driveway, called out breezily, "Hi, boss!"

"Hi, kid!" Gus returned just as breezily, and started for the office. "How're things?" he asked, unable to hide his anxiety.

"Swell, just swell," Stan assured him in a matter-of-fact tone.

Joe Clark was just as placid. His eyes twinkled delightedly from behind his horn-rimmed glasses, but all he said was, "Have a good time?"

"Fine!" Gus told him. "It's good to be back, though. I've been sort of worried about things."

"You needn't have been," Joe assured him. "Everything's gone O.K. Plenty of work, but all of it routine stuff that Stan and that Mike Cawthorne you hired could handle without any headaches. I let Mike go yesterday, knowing you'd be back today."

Gus grunted. He was relieved—and a little deflated at the same time. "There's no indispensable man even in a garage," he told himself with a rueful mental grin. Aloud he remarked that he had his best suit on and had better go home for a change before getting to work.

As he started for the office door it was opened violently ahead of him, and a tall, thin, glum man he didn't know stomped his way in. His thin lips mouthed an unlighted cigar as the visitor looked the partners over, an expression of bitter dissatisfaction on his lean, dark face.

"There never has been a time," he declared solemnly, "when automobile mechanics charged so many so much for doing so little. Maybe Winston Churchill didn't say that—but he would have, by gum, if he'd had any work done on his car!"

Joe bristled. "Why, Mr. Downunder . . ."

"Underdown, if it's all the same to you," the sour man corrected acidly.

Joe reddened. "Yes, of course—Mr. Underdown," he amended. "What I was going to say—I mean, what's the matter?"

Underdown dexterously rolled his cigar from one corner of his mouth to the other.

"You remind me of a doctor I had a couple of years ago," he said slowly. "Sold me an operation—said if I had it I'd cut six strokes off my golf score. That would have brought me down under 90, so I had the operation—cost me a thousand before I got through with it. It didn't do what the doctor said. I've never broken 90."

"That's—that's too bad," Joe said uncertainly. "But what's it got to do with your car?"

"Same sort of deal," Underdown went on. "You sold me a motor tune-up, didn't you? You claimed it would give my old bus more power and a quicker pickup, didn't you? You claimed—"

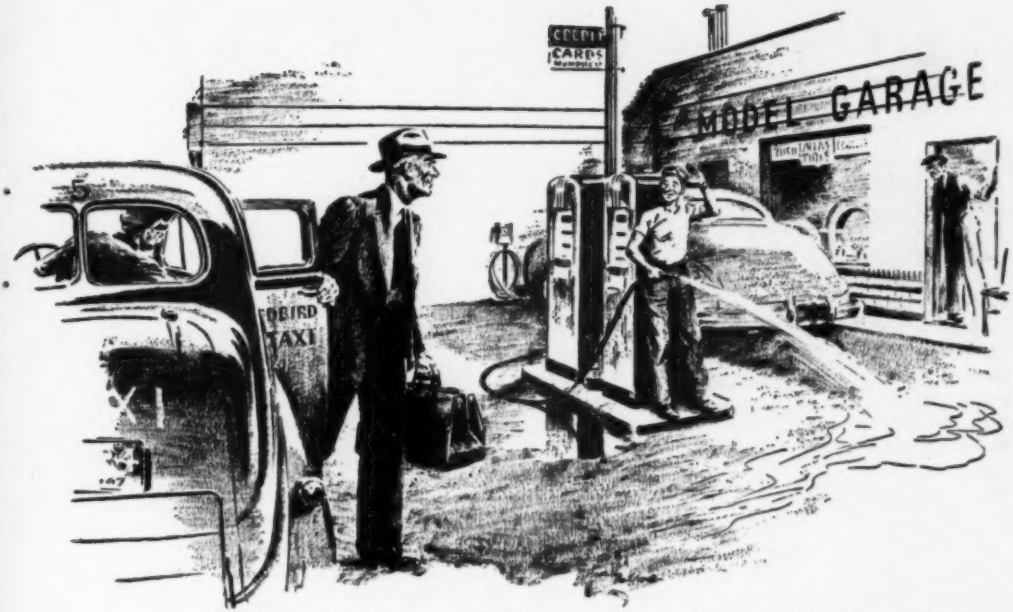
"Well?" Joe broke in.

"Well," Underdown mocked. "It's just like my operation. The motor runs O.K., but not the way the doctor claimed it would. It hasn't got any more power, and its pickup isn't any faster than it was before the operation. I'm not satisfied I got my money's worth—that's flat!"

Joe gave Gus a get-me-out-of-this look, and Gus went to his assistance. "If you've got your car outside, Mr. Underdown," he suggested, "suppose you and I take a little ride in it? Maybe I'll be able—"

"You're Gus Wilson, I suppose," Underdown said. "Feller told me you're a whiz. That's why I brought my car here."

They went out to a 1939 sedan. Gus slid behind the wheel. The engine ran smoothly enough, but when they got on the highway and Gus pressed his foot suddenly on the



Joe grinned a welcome from the door, and Stan, in slow-motion at the morning hosing, called, "Hi, boss!"

accelerator pedal, the power plant's response indicated that Underdown had a real kick coming. Noticeably lacking was the flashy acceleration to be expected from a job just out of the shop with a good tuning. And when they climbed a fairly steep grade, there wasn't any power to spare.

"You win," Gus told the customer. "She isn't as good as she ought to be. If you want to leave her until quitting time this afternoon, I'll see what can be done."

AFTER Gus had driven the sedan into the shop, Stan came over to him. He looked embarrassed. "Say, boss," he began, "I've got to talk to you."

"Go ahead and talk," Gus told him.

Stan had turned red, and his grease-smeared face showed drops of perspiration.

"You've heard about the high cost of living and everything," he blurted out.

"I've more than heard about it," Gus assured the youngster.

Stan hesitated, looking miserable. Finally he stuttered, "I–I ought to get a–a raise."

"Why?" Gus asked.

Stan turned still redder. "Oh, I dunno," he muttered.

Gus laughed and gave him a friendly poke in the ribs. "You certainly don't rate a raise for being a good salesman for yourself," he said. "I'll think it over and see what Joe says about it." He indicated the sedan. "Remember this job?"

Stan nodded. "It was in for an engine tune-up a couple of days after you left."

"Who did the work, you or Mike Cawthorne?" Gus asked.

"Mike did, mostly," Stan told him. "I helped, but he wouldn't let me do much. He's the sort of guy who thinks he's the only one who knows anything."

"Either of you road-test it after it was finished?" Gus wanted to know.

Stan shook his head. "No. Mr. Clark did. He said it was O.K."

Gus tried not to grin. "It's not O.K. now," he said. "There's not enough pep. Let's check the engine."

It ran smoothly. The vacuum tester didn't indicate that there was anything the matter. But, just as had been the case on the road, when Gus stepped on the accelerator pedal the engine didn't answer instantly. He checked the carburetor, and found that it was working normally. Then, after some silent thinking, he had Stan remove the manifolds from the block and examined them.

The inside of the intake manifold was covered with a brown varnishlike coating, and

His thin lips mouthed an unlighted cigar as the visitor looked the partners over, an expression of bitter dissatisfaction on his face.

the inside of the exhaust manifold had an uneven but generally thick carbon deposit.

Gus shook his head sadly. "Sloppy work," he commented. "I thought better than that of Mike Cawthorne. He probably cleaned out the inside of the manifolds, but he didn't do a thorough job. He left some of the old deposit of varnish binder in the intake and some spots of carbon in the exhaust, and new deposits built up quickly."

Stan's face got red again. He looked as if he wanted to say something, but for a long moment he was silent. Then he blurted: "That wasn't Mike's fault, boss. He gave me the job of cleaning the manifolds. I was sore because he wouldn't let me do anything more important, and I guess—I guess I wasn't careful enough."

Deep gloom shrouded his usually cheerful face, and he spoke aloud his gravest thought: "Now what chance have I got for a raise?"

Gus managed to smother a grin. He looked at his young assistant and shrugged his shoulders. "Well," he said, "you'd better get back at them with a wire brush. And make sure this time you get them thoroughly clean. It would be easier to soak them overnight in a gum solvent—ethyl acetate or something like that—to loosen the deposits and then clean them off with an air jet, but I promised Mr. Underdown I'd have his car ready this afternoon."

Stan went to work, and when he brought the manifolds to Gus an hour later the inner passages of both had been polished clean and smooth.

"O.K.," Gus approved after an inspection. "That's the kind of job you should have done the first time. And here's something to remember. If you ever use a gum solvent to get the varnish binder off inside an intake manifold, be very careful to remove all the loosened matter afterwards. That stuff can cause real grief if it gets carried into an engine."

When Stan had reinstalled the manifolds, they took the car out for a road test. Gus pressed his foot down, and the old sedan leaped ahead. Its acceleration was really flashy. And when they climbed a hill, there was plenty of power and then some.

Stan shook his head in bewilderment. "I don't get it, boss," he said. "I know I did a bum job cleaning those manifolds the first time, but I don't see how the little carbon and stuff I missed could make all that difference."

"Ever see the manifolds of a racing car?" Gus asked. "Their inside passages are plated—or well polished, at least—to improve the volumetric flow of the mixture and of the exhaust. To get the most out of an automobile engine, those passages must present the least possible friction so the pistons can suck in the largest possible charges of mixture and expel the largest possible volume of exhaust gases.

"You don't find plated manifolds on anything but real hot-rod jobs; but whatever kind you have, they must be clean and smooth to get top performance out of the car. The deposits that built up quickly on the rough spots you didn't get rid of interfered with the easy flow of mixture and exhaust in this engine, so it had a sluggish pickup and couldn't deliver full power. Get it?"

Stan thought it over. "Yes," he said finally, "I get it. Say, auto engines are sort of funny, ain't they?"

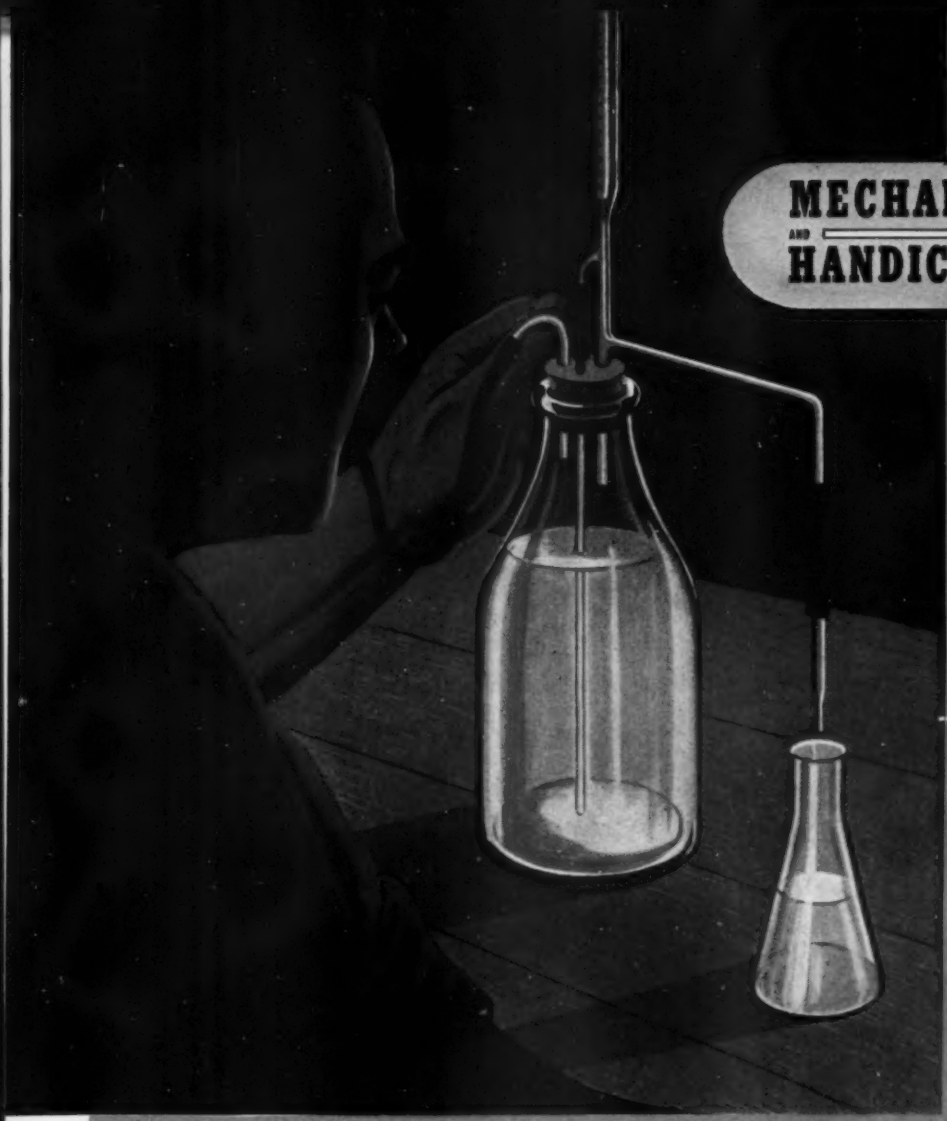
"You're telling me!" Gus agreed grimly. "By the way, I spoke to Joe about your wanting a raise."

Once more Stan's face got red from embarrassment. "I guess I haven't got it coming to me now—after that punk job on Mr. Underdown's manifolds," he muttered gloomily.

Gus laughed good-humoredly.

"We all have to learn the hard way sometimes," he said after a moment. "And you didn't let me think that it was Mike's fault. Your pay envelope will be five bucks fatter this Friday, son. O.K.?"

"O.K., boss," Stan grinned.



MECHANICS AND HANDICRAFT

- Homemade Lab Equipment
- Flexible Couplings
- Sports Photography
- Quality Audio Amplifier
- Servicing Gas Stoves

All fastenings must be tight to make a steady table. Nuts on the machine screws holding the legs are put on the inside. The stretcher goes only part way into the outer legs. Wax or varnish completes the job.

Coffee Table Has Ax-Handle Legs

UTILITARIAN good looks, associated with the first furniture of our American forefathers, who used whatever material there was at hand, is captured in this coffee table assembled from a breadboard and four ax handles. The pieces may be old or new. A 15″ length of ⅜″ dowel is needed for the stretcher, and four 2″ angle braces to join the legs and top.

Prepare the breadboard by rounding the corners and edges and sanding smooth. Be sure to sand only with the grain, masking the strips running crosswise at the ends when working lengthwise on the main boards.

Take care also in sawing the ax handles to length. They are pretty well standard, but the bevel on the handle ends may vary and the saw cuts must be made parallel to this bevel so the cut ends will fit flat against the top while the bevels rest flat on the floor. Lay each out separately with a carpenter's square, providing for a 17″ or 18″ table height and taking into account the thickness of the breadboard.

Flatten slightly the surfaces where the legs cross and those on which the angle braces will fit; then drill for the stretcher and the machine screws that hold each brace. Assemble on the stretcher with glue, and screw to the top.—ROLAND CUEVA.

Desk Name Stand Bent from Sheet of Plastic

A SINGLE sheet of 1/16″ clear plastic can be formed into a crystal-like desk stand to hold your name on a 1″ by 7″ strip of cardboard. The plastic is bent at two places over a ⅜″ thick strip of wood.

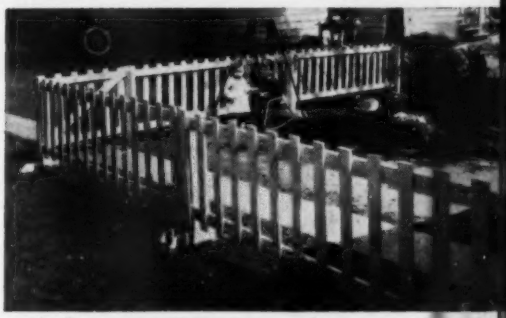
Sand the edges smooth and remove the masking paper. Heating may be done in the oven at 250 deg. or, perhaps easier, it may be only along a strip ½″ wide where the plastic is to be bent. This can be accomplished by masking with asbestos and using a heat lamp.—FRANK SHORE.

Set up as a pen, four fence sections and gate form an area in which a young child can play with safety.

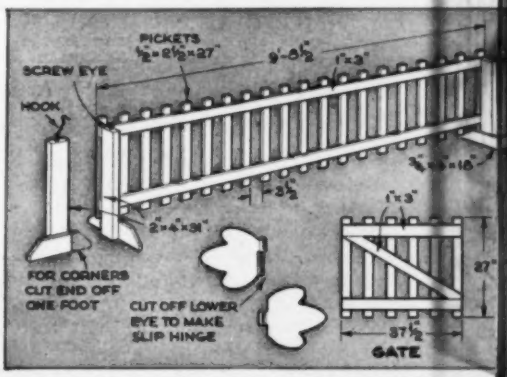
Portable Fence Grows with Baby

FOR a child that is learning to walk and has outgrown the regulation folding pen, a portable enclosure can be set up on the lawn. This one, resembling a picket fence, is built in sections and is easily taken down and stored when not in use. Unlike the indoor pen, it can be enlarged as the child requires more play space by adding sections or sometimes even by rearranging those on hand to join the property fence and house.

The posts are two-by-fours with crosspieces nailed to the bottoms so each section will stand alone. Top and bottom rails are lengths of 1" by 3". Pickets are cut from ½" stock. They are spaced wider than usual so the baby can see out and will not feel boxed in. If the bottom hinge eyes are cut off, the gate can be lifted off readily to facilitate moving. By extending the pickets to the ground, the fence can be used for a puppy's run.—DICK HUTCHINSON.



As the baby grows, the sections can be rearranged or others added to provide more room for activity.



Fence sections are all built alike and are joined with a hook and eye at each corner. The feet are crosspieces. If a perfect square is desired, one section may be shortened the width of the gate.

White paint is usually acceptable for fences, but children enjoy bright colors. Sand smooth before painting to avoid the danger of splinters.

Circle Within Circle Is Stand for Flowerpot

Two wooden rings and a disk, turned in the lathe or cut with a coping saw, form the parts for a stand that frames a flowerpot while also serving as its support.

In the stand shown, the disk base is 6″, the ring for the standard 7″ o.d. and 5½″ i.d., and the pot holder 5¾″ o.d., the inside fitting the taper of the flowerpot. The rings are turned with a square edge inside and a ¾″ radius on the outside, a form that permits turning and finishing before cutting off. Likewise, the top arris of the base is turned to a ¾″ radius. If the work is done by hand, a rasp and sandpaper will finish the edges quite neatly. Be sure to measure the outside diameter of the flowerpot just below the lip, and change the dimensions, if necessary, to suit.

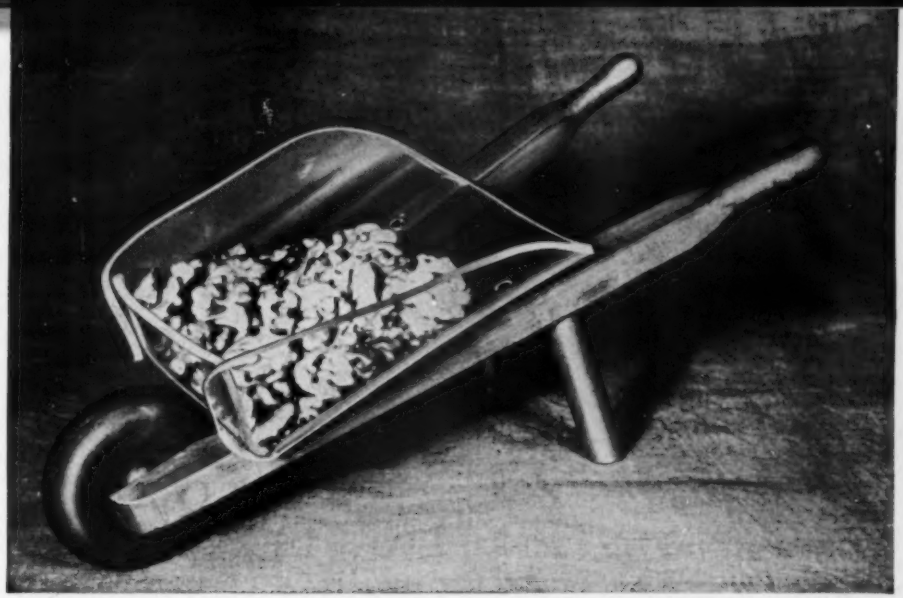
Allow 1/16″ clearance between the rings so the inner one can be swiveled for removing the flowerpot. Drill for copper or brass pivot rods, with temporary wedges between the rings to maintain the 1/16″ spacing. Flatten the bottom of the outer circle and screw the base to it. Finish with oil stain and wax.—R. J. De Cristoforo.

Pie Tins Used As Wall Plaques Display Decals

Painted pie tins decorated with interesting decals make attractive wall plaques. As craftwork projects, they're just the thing for children who want to work alongside Dad on something of their own. The plaques shown here were ordinary tins from a dime store.

Drill a hanging hole near each rim if the tins don't already have them; then paint inside and out to avoid rust even though the inside will be against the wall. White or a pastel shade is best on the bottoms to serve as a background for the decals. Borders may be a contrasting color to harmonize with both the decals and the room. Take care to apply the decals so they will hang straight.—William E. Danneman.

Clever wall decorations at a cost of a few cents. These plaques are common pie tins well disguised with a coat of paint and a pair of decals.



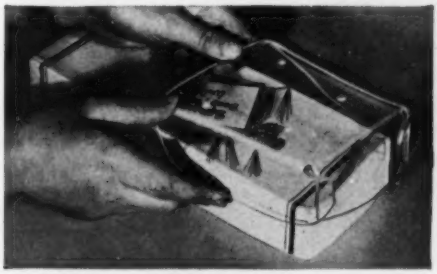
Snacks, candy, or salted nuts are offered attractively in a plastic dish mounted on a midget wheelbarrow.

Wheelbarrow Serves Tidbits

SHAPED from a sawed blank of thin plastic, this crystal-clear wheelbarrow body attractively serves bonbons or nut meats. The project can be a one-evening job.

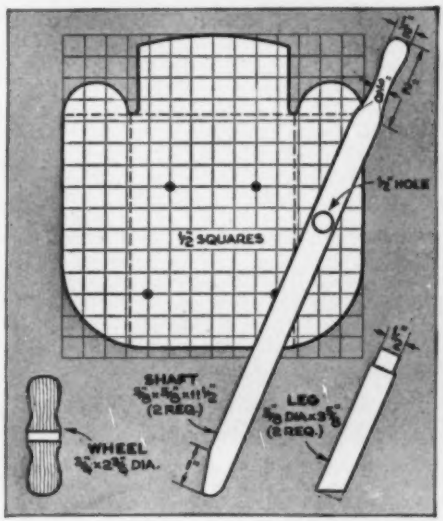
Heat the plastic blank to 250 deg. in an ordinary oven, and bend up first the front, then the sides, and finally the rounded flaps around the front end. Hold for a few moments until the plastic retains its shape.

Hold the shaped body on the barrow frame and with a scriber spot the mounting holes on the plastic to overlie the shafts. Drill and countersink the plastic for tiny brass or nickeled screws.—ELMA WALTNER.



Bend the body from heated plastic over a stiff cardboard box or on a block with rounded corners.

Dowel legs are glued into shafts having turned or carved handles. The axle is also a short dowel.



It's Copper for Candlelight

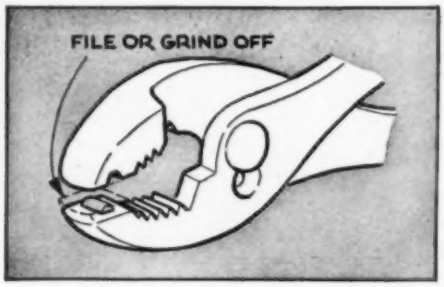
Gleaming candlelight is reflected in the burnished finish of this copper holder designed and executed for PSM by Morton Bartlett and James Harris.

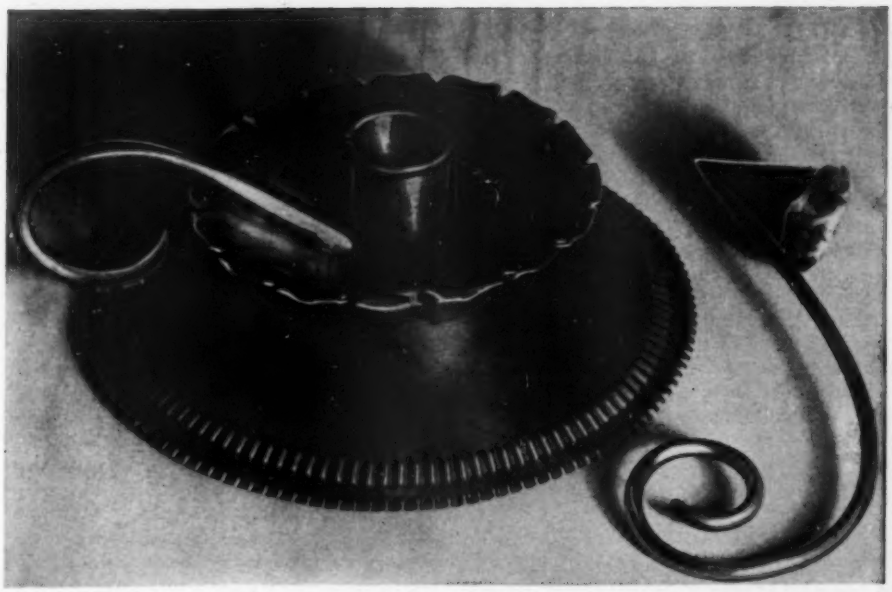
FEW metals are as easy to work as copper sheet and still so suitable for display pieces in the home. It is ideal for candlesticks. The two shown here and in full color on page 136 consist of cones, crimped and otherwise decorated on the edges and soldered together. They have a subdued richness that catches the soft glow of candlelight and reflects it with reddish overtones.

Soft 16-oz. (24-gauge) copper was used for both projects. It is stiff enough to give good body to the cones, and yet it is sufficiently pliable to be worked without resorting to bending jigs. The metal transmits heat rapidly, so a fairly heavy iron or a small torch must be used, especially on the longer joints. It is wise also to clamp the parts with a rivet or two where convenient before running in solder.

Decorations are put on while the cone-shaped pieces are still flat. Though the markings can be applied with regulation chasing tools and the like if they are at hand, simple homemade tools were used for the two pieces shown. A set of gears mounted on a sturdy steel block will be found excellent for crimping, a pair of pliers filed or ground for a bead on one face and a mating slot on the other is a first-rate chasing tool. Such ornamentation as the scalloped cup of the candlestick on the facing page is done by filing notches, further indenting with a dull chisel, and finally peening.

Decorative edging is put on with a crimper made of two gears on a steel bar. Complete directions for assembling such a tool are on page 170.



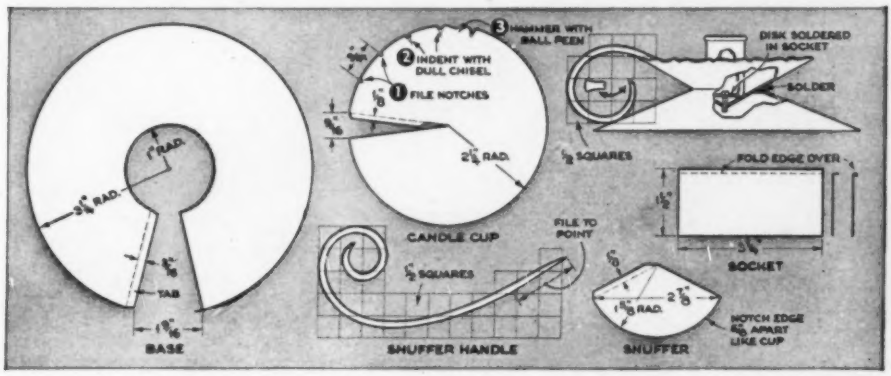


Copper lends itself to antiquing as well as a bright finish. How to antique it is explained on page 171.

The drawing below gives dimensions for this holder. Lay out the radiuses for the cut sectors and indicate the overlapping tabs. Cut the sector and inside circle out of the base, after which the decorative edges can be worked and the piece rolled and soldered into a cone. Solder the cup into the base cone with the seams aligned. Next, bend the handle from 3/16″ copper rod or tubing. The scroll end is hammered flat and filed smooth; the other is cut to a bevel against the socket.

Cut a piece of copper for the candle socket, and bend one edge back on itself. Then, with the fingers, shape the strip around a 7/8″ rod, pipe, or dowel. The bent

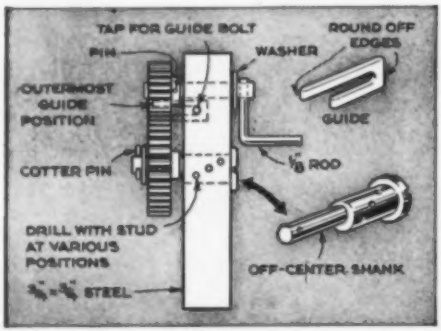
Candle sockets are easily bent around a length of rod of candle diameter. The folded edge closes to form a neat roll during the process.



edge will close further, forming a neat roll, and only the ends may have to be helped with round-nose pliers. Cut the ends to size and solder them; then solder in a washer or disk drilled for a machine bolt. Center the socket in the cup and drill through with an undersized drill for the machine bolt, which will cut its own threads in the soldered copper joint.

Mark around the socket, remove it, and solder the handle on just behind the socket line and along the cup seam, which it will conceal. A touch of solder secures it to the base. Polish or antique the parts, and assemble the socket with the bolt.

The snuffer involves no extra problems, but the scroll handle should be of 1/8" stock. It, too, is soldered to the cap along the seam and filed to a tapered end.

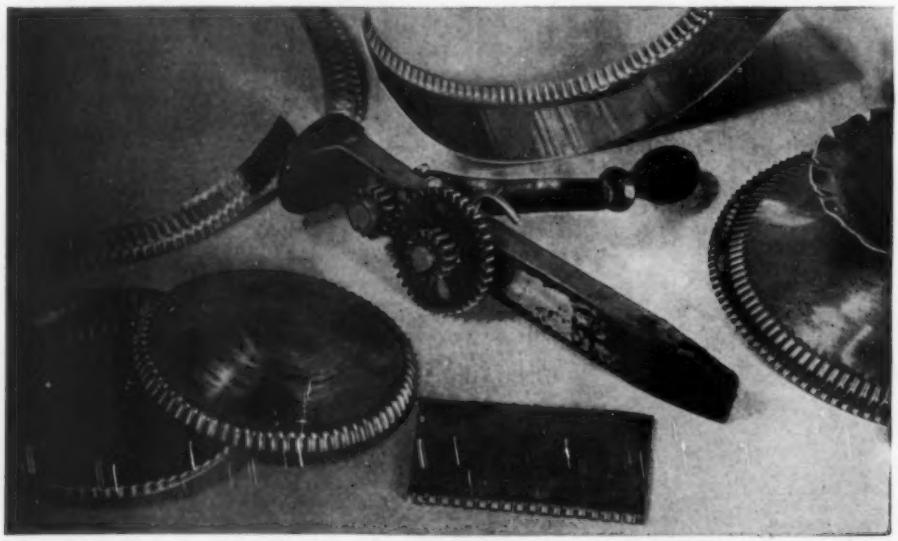


This is one way a homemade tool can be built for applying neat, uniformly spaced edge crimping.

Except for dimensions, the candlestick on page 168 is made up just as the other. The base is from a disk having a 3¼" radius with a 2" sector, measured on a chord, cut out. Its center hole is only ½" in diameter. For the candle cup, use a 2¾" disk with a 2¾" sector cut out. Crimp and turn the edge up with the pliers shown. The reflector is a disk of 4" radius with an 11/16" sector.

A ring handle can be cut easily from ⅛" copper rod or wire wound on a 2½" diameter wood form. If several are to be made, wind the required number of turns, let the wire open up into a natural spring, and saw across the turns. Solder to the base at the joint.

You can make a crimper from two steel gears, not necessarily of the same size but of the same pitch (3/32" to 5/32") and preferably case-hardened. The body may be bar steel or an old railroad spike. One gear is pinned to a shaft that is a free-turning fit in a hole in the body. It carries the handle. The other is left free to turn on a stud, which may be a push fit in the body. If the gear shaft on this stud is turned off center, some adjustment will be provided for work of various thicknesses. The stud will then be held in the body by a removable pin. Two slotted guides vary the distance of the crimp from the edge. END



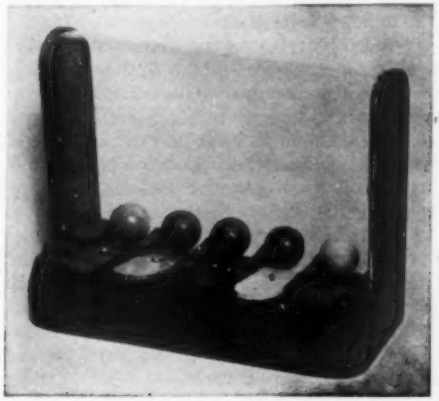
A crimper mounted on a railroad spike and some edges it makes. The handle is from a pencil sharpener.

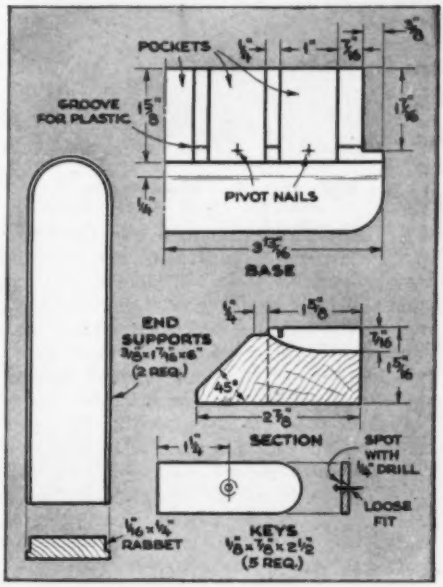
Ball Toy Teaches Colors to Child

WITH this educational toy, a young child will have a lot of fun and also quickly learn to identify the five colors—red, blue, yellow, green, and orange—represented by the keys and bouncing balls. A plastic shield confines the balls.

The base, two end pieces, and five keys are cut from hardwood. Suitable balls and a mallet for striking the keys may be turned or salvaged from another toy.

When the wooden parts have been cut, assembled, and stained or painted, draw a pencil line across the base block from the front face of the rabbet of one end support to the other. Then center the keys in the grooves and fasten with escutcheon nails about 1/16″ outside this line, making them loose so the keys work freely. Where the pencil line crosses the partition between the grooves, cut shallow channels and cement in the front edge of a 7¾″ by 11″ sheet of 1/32″ cellulose acetate. After putting in the balls, tack the plastic to the rabbet and back of the base.—JOHN P. ARNOLD.





ANTIQUING COPPER [SHOP METHODS]

When the natural color of copper or a highly polished finish is inappropriate, it is a simple matter to give it a more subdued "antique" or French finish. Such a finish ranges from coppery red with a brownish cast to a blue-black. Accents for purposes of texture or ornamentation are easily achieved by embossing or engraving some parts in low relief. Dark tones will remain in such portions while higher parts are highlighted to varying degrees.

Dissolve about 1 cu. in. of potassium sulphide (liver of sulphur) in a pint of water. Add six drops of ammonia. Clean the copper thoroughly or dip in an acid pickle to remove all dirt and grease, and rapidly swab on the solution. The metal will gradually darken to black. With a cloth or toothbrush, and clear water, rub off the outer black deposit immediately. If the metal is not then a deep brown-black, clean thoroughly and repeat the process. Wash well and dry off.

With very fine steel wool, rub to bring out the tone desired. The less rubbing, the deeper the tone. Excessive rubbing will restore the copper to its natural color. It is at this point that recessed parts can be left dark, while high parts are brightened to a lesser or greater degree. A smooth surface can be given an attractive mottled appearance by judicious use of the steel wool, some spots being left darker in tone than others.

The finish should be protected either with clear metal-finishing lacquer or by several coats of good-quality wax, each left to harden and then polished.

Aside from embossing, peening, crimping, and other worked effects that are set off by the treatment, considerable variation in the effect on a smooth surface is possible by polishing, scratch-brushing, sandpapering, or rubbing with coarse steel wool before treatment. The deeper the scratches left, the more dark tones will tend to remain, and the more "grain" and deeper the tone the finish will have.

For the same reason, work should be free from undesirable scratches, scoring, gouge marks, and the like, as all these will be emphasized by antiquing. The exception, of course, is work that is to simulate the battered appearance of use and age.

POPULAR SCIENCE MONTHLY SHOP DATA

Hinged Model-Train Table Folds Up

By H. A. Machlan

WHERE lack of room will not permit the permanent installation of a model-railway layout, this table will fill the bill. The tracks can be attached to it permanently, and yet it can be folded compactly and stored out of the way when not in use.

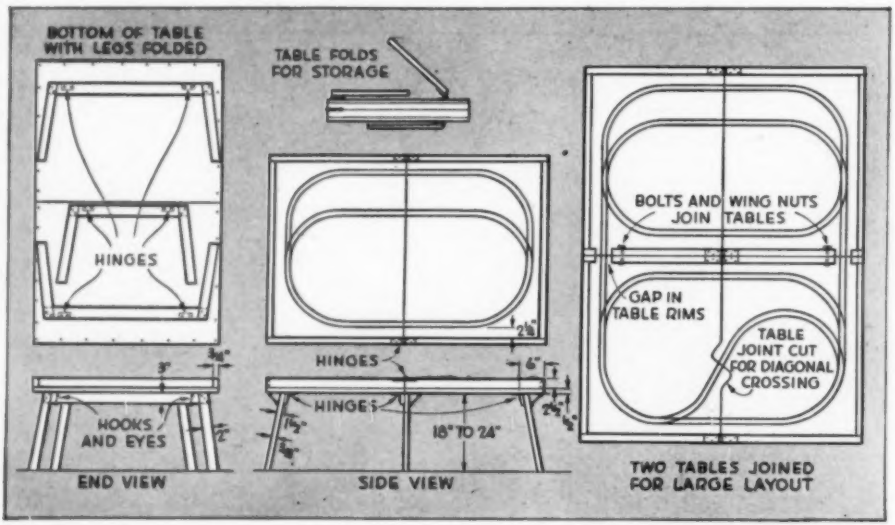
Dimensions of the table top will depend upon the track layout. The best way to decide is to make the layout on the floor and measure its length and width. Then cut two panels of ½" plywood which together will be 3" larger all around than the layout.

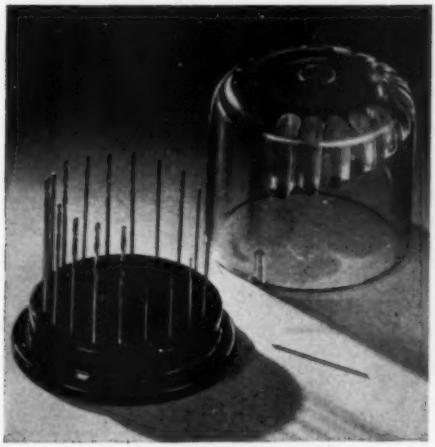
Nail a ¾" by 2½" rim on three sides of each half, and join the two with hinges on top of the rim. Make up three pairs of ¾" by 2" legs, joining each pair with a 1½" by 3" lapped crosspiece, and hinge them to the table. The center pair should be narrow enough to fold inside one end pair. They are hinged ¾" from the table joint so the 1½" crosspiece will cover the joint and act as a support there.

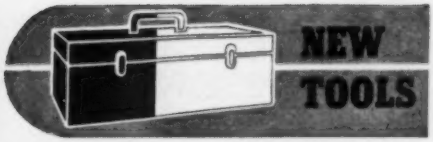
One way to finish the table is with a heavy coat of grass-green paint on the layout surface. Sprinkle lightly with dyed sawdust for a close approximation of grass. Slate-gray asphalt roofing shingles are then cut into strips and attached with roofing cement as a roadbed. Lay the tracks so a joint will come exactly at the table joint, remove the pins at this joint, and solder jumper wires across, making them long enough to allow the table to be folded.

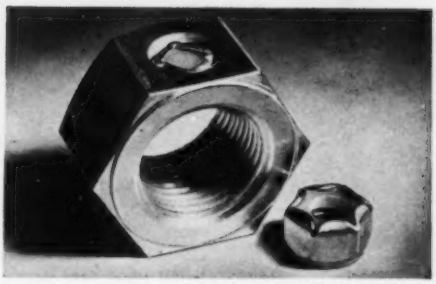
Some controls can be mounted permanently on the table since a 5" headroom is provided by the rims when it is folded. The transformer, since it is heavy, is best used on a separate small table or stool and stored separately. It can be connected to the rails by means of a pair of Fahnestock clips permanently mounted on the table.

As the railroad trackage grows, additional tables can be set up and joined at the rims with bolts and wing nuts. Have track joints come at the table edge. A method of cutting the table joint for a diagonal crossing is shown in a drawing. Soldered jumper wires are also used there.





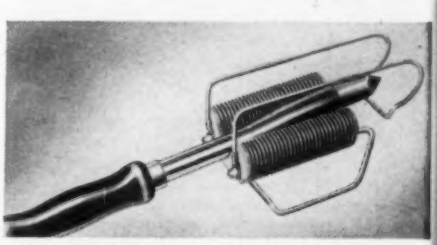


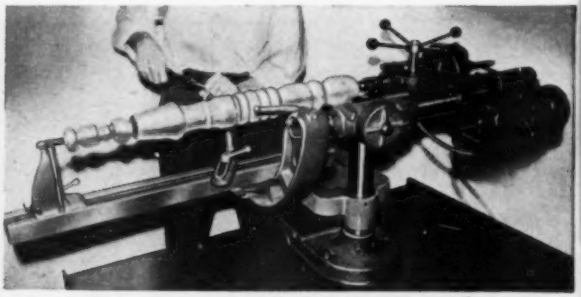


Safeguards Drill Set. Fine drills from No. 61 to 80 are protected and kept in order by this plastic stand and case. Each hole in the stand is just large enough to accept a drill of a given size, that of each hole being marked on the face of the stand. The product is manufactured by V. F. Rogers, of Denver, Colo.

Lock Nuts Use Nylon. In lock nuts made by the Nylok Corporation, New York, nylon inserts serve as the locking medium. In the larger, thrust exerted by a nylon plug in a hole on one side gives a wedging action. In the smaller, metal is crimped over a hexagonal nylon washer. Another company makes a wing nut with a nylon locking collar.

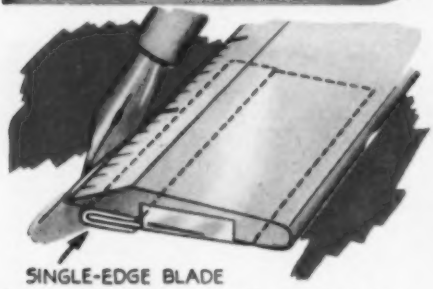
Stand Protects Iron. A soldering-iron stand made by the Beyer Manufacturing Company, Omaha, Neb., serves two purposes. It provides a handy place to put down a hot iron, and the aluminum radiation fins draw off excess heat while the iron is at rest, preventing oxidation and burning of the tip and prolonging the life of the heating element. The stand is priced at $3.75.





Drill Press Used as Lathe. With an attachment made by the Nobur Mfg. Co., of Los Angeles, a drill press having a 2½″ or 2¾″ column may be changed back and forth in a few seconds for use either as a wood lathe or a drill press. Installation requires only substitution of a two-piece column with a swivel joint for the regular column. When a lathe is needed, the drill press is turned horizontal and the lathe bed is locked to the table. Work up to 36″ long is accommodated by the lathe.

KEEPING the HOME SHIPSHAPE

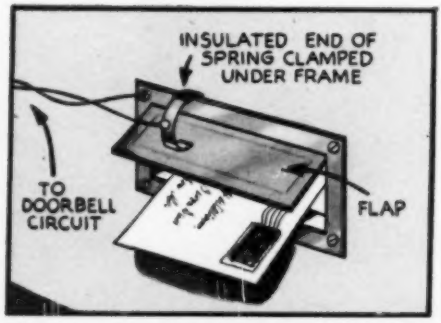


A ruler will be less likely to blot inked lines if you tape a single-edge razor blade under each end. This raises the ruler enough to clear the paper.

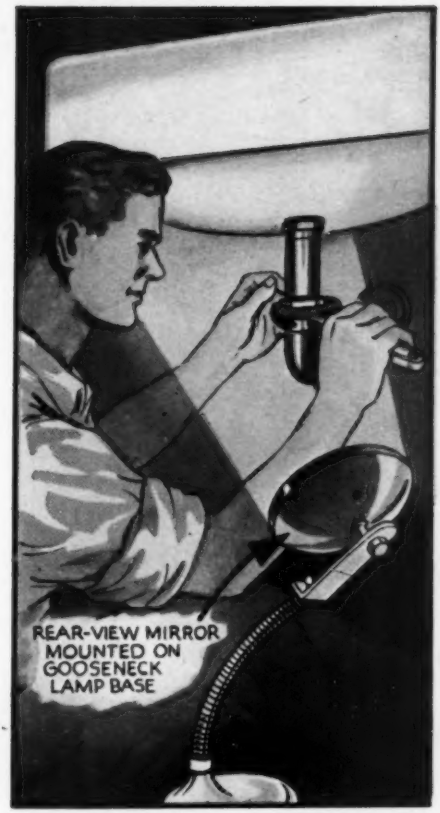
Frequently used recipe cards from your file box will withstand kitchen wear better if you protect the print with strips of cellulose tape. Lap the tape and press it tight to make it water-resistant. You can then wipe off any spots with a damp cloth.

Empty waxed-cardboard milk containers have many household uses. Cut down and used as containers for leftover foods, they make fine refrigerator-space savers. They are also excellent for soaking paint brushes, as molds for homemade soap, or, cut lengthwise, as disposable dishes for feeding pets.

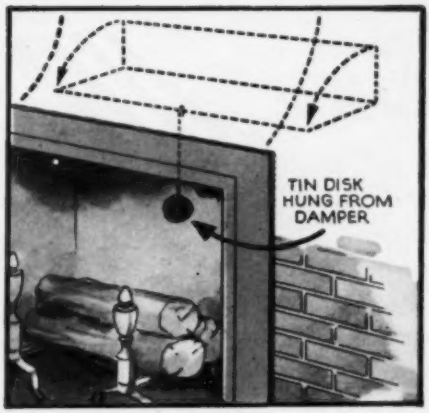
Grapefruit can be used up twice, the first time in the eating, and the second by using the rinds as handy cleansing pads for copper and copper-clad utensils. Sprinkle some salt on the pulp and rub the copper surface. Salt and acid remove tarnish.



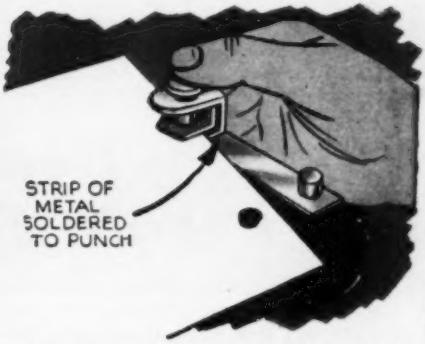
The postman sometimes rings twice, and sometimes not at all. But you can always tell when mail is dropped through your letter slot if you use the bell-ring circuit shown above. The flap forms one contact, and a bent spring-metal strip the other.



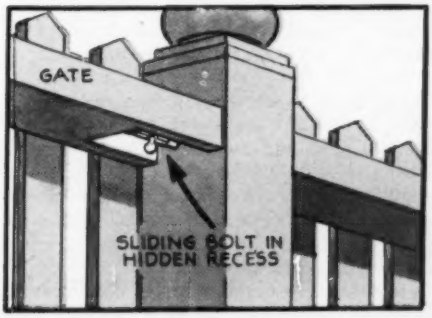
Throwing light exactly where you need it is a cinch with the mirror and gooseneck rig shown above. It's especially good in jobs where an extension-cord lamp isn't available or else can't be plugged in. The mirror is also valuable in letting you look behind obstructions when working in cramped quarters.



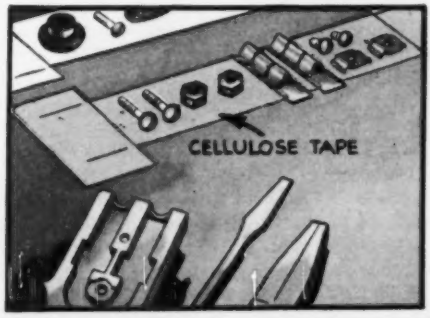
There's no need to forget the damper and light a fire in a closed fireplace when a metal disk suspended by a wire makes the damper position clear.



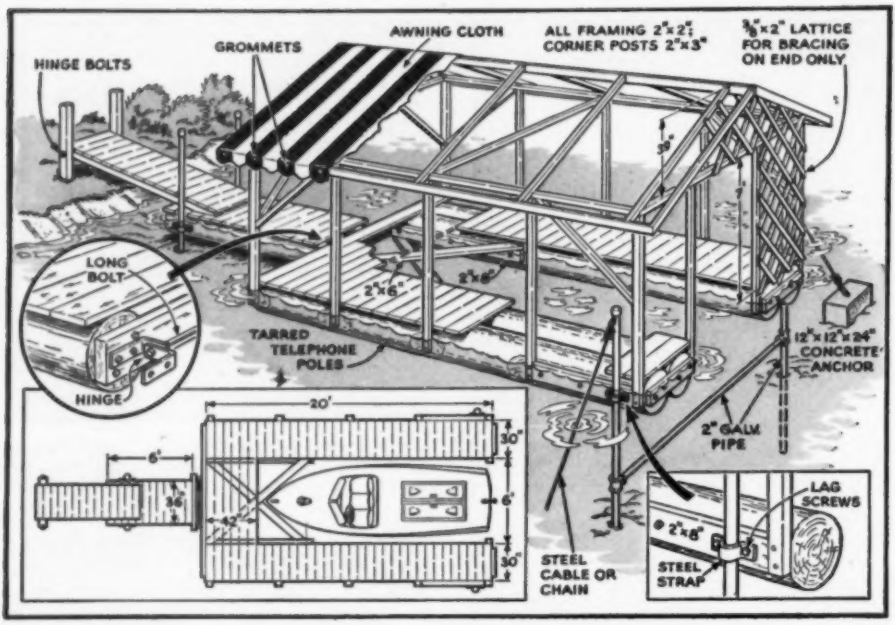
If you have a punch of the type shown and find it difficult to space holes properly, try this spacing jig. Solder a metal strip to the base of the punch, and solder in a pin at the right distance.



If your house is so situated that the yard is used as a public thoroughfare by people in search of a short cut, here's a device for reducing traffic. A lock concealed in the upper stile lets friends in but keeps out strangers who aren't in the know.



When disassembling locks, cameras, or other small mechanisms, parts that are easily misplaced may be kept under control by placing a strip of cellulose tape on the workbench, sticky side up. Parts will adhere lightly and remain in order for reassembly.



Floating Boathouse Has Picnic Terrace

FRAMEWORK construction and a canvas roof will provide protection for your boat from sun and rain. In addition, the boathouse shown floats on the surface of the water, rising and falling with the tide, and has an ample boardwalk for picnicking.

The framework floats on discarded telephone poles in the drawing, but logs, empty oil drums, or the like would do as well. Boats up to 5½′ beam and 16′ length can be accommodated with the dimensions given. Tarred all over, the telephone poles will remain buoyant for a long time. If only short lengths are available, the joints should be staggered. Wooden saddles are easily made for holding oil drums to the framework. A log boom out a short distance from the entrance will be a protection if open water is faced.

Side drift is prevented by two galvanized pipe pilings guyed to concrete-block anchors. The open end of the structure is braced with lattice work. If this is painted white, it will also serve as a guide in bringing the boat to port in the dark.

Use two poles or four oil drums under each side deck. Lag-screwed crosspieces hold them together. Studs and posts are lag-screwed also to flats trimmed in the logs, and the structure is braced at all corners. The awning should be fitted with grommets so it can be removed in winter. While the open framework offers little protection against the wind, the shelter will generally keep rain out of the boat.

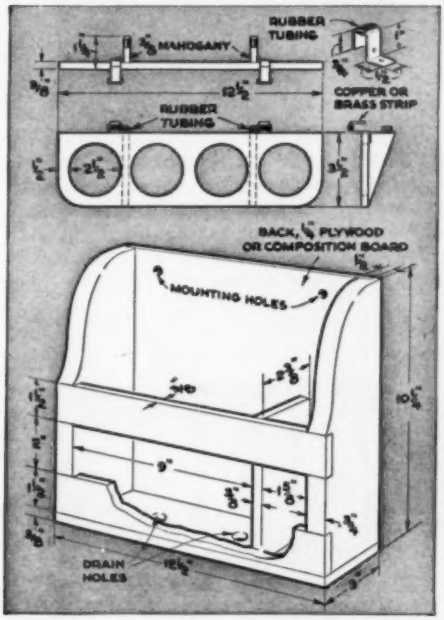
Assemble the pipe piling with tees in the shape of an *H* and drive it into the bottom with a sledge hammer. Give a few taps on one side and then on the other. Or better still, if you have a helper, drive simultaneously while using the float itself as a platform. The unit should be driven in deep enough for the crossbar to be 6″ below your boat at low water.

Jockey the concrete anchors into position with the cables handled from a boat. The guys should not be drawn so tight that they pull the tops of the pipes out of the vertical.

Hinge the ramp at the shore end to compensate for varying water level.—HI SIBLEY.

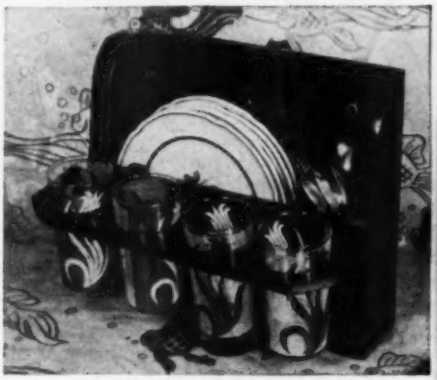
Two-Way Rack Holds Dishes Aboard Boat

In the cabin of a small boat, where every inch counts, a side rack will care for a supply of dishes, glasses, and silverware. This one holds a table setting for four persons. The glass carrier can be lifted off and passed around. It could be enlarged to hold still more tableware, including saucers for coffee cups kept on cup hooks screwed to the bottom.



Lightly nail together ¾" mahogany or other stock to cut both ends to shape at once, and notch for the front rails; then separate and rabbet the pieces for the back. Cut the rails, partition, and bottom from ¾" solid stock. Assemble with waterproof glue.

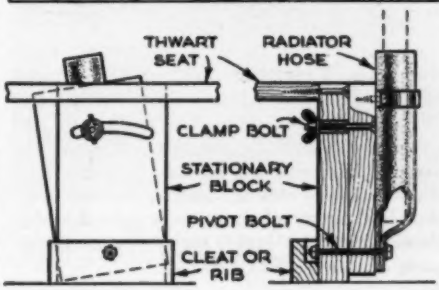
Cut holes for tapered glasses in the detachable glass holder that hangs on the top rail. Then glue on the triangular pieces to brace it against the front of the dish rack.



Adjustable Socket Handles Trolling Rod

Hours and miles of holding a trolling rod against motor and tide can become tiring to even the most ardent fisherman. Sportsmen on Buzzards Bay, Mass., have rigged up a gadget for their boats that relieves the strain and permits them to relax completely when they wish.

The device consists of two blocks of ¾" oak or other sturdy wood carrying a rod socket adjustable to various angles. One of the blocks is slotted for a clamping bolt and attached rigidly to such parts as the thwart seat and a rib or cleat. The other is held to it with a fixed pivot bolt and the clamping bolt. Cut the socket from automobile radiator hose, which is soft enough not to scratch the rod and stiff enough to give it adequate support, and mount with the pivot bolt and a pipe clamp. All parts should be given two or three coats of good boat paint.—Bruce MacIntosh.



WHAT'S YOUR INGENUITY QUOTIENT? IQ

Chimney Crickets! No, the sounds that come from my chimney aren't caused by insects. When I removed the stove pipe, instead of using an ordinary flue stop, I stuffed the gaping hole with an-extra loudspeaker and covered it with a decorative grille. The loudspeaker, of course, is connected to the main radio in another part of the house.—CHARLES FARNSWORTH.

Having Trouble, Jack? Or jack trouble? In my case it was the latter. I had a flat on a lonely stretch of dirt road and no jack with which to lift the baggy tire off the ground. So I put a rock solidly under the axle and dug a hole 6" deep under the tire. That left plenty of room to wiggle the old wheel off and to wiggle on the pumped-up spare.—CHARLES STARNES.

It Keeps Me In Stitches. Even up in our vacation cabin, where electricity hasn't yet arrived, I can still get a sharp seam out of my electric sewing machine with the aid of my husband's grindstone. A belt drive from it to the machine pulley gives plenty of speed and control, since the grinding wheel turns nine times for each swish of the handle.—MRS. A. R. GREEN.

Hang It All! I've always found it annoying to have my coat draped around me during a long train ride, but it used to happen whenever I hit a train that had no coat hooks. Then I discovered that the luggage racks overhead were really clothing hangers in disguise. All that's needed is a pencil slipped through the loop or label in the neck of the garment. The pencil is then placed crosswise so as to rest on two parallel bars of the rack.—THOMAS P. RUSSELL.

Have you pulled off a smart one lately? We will pay for acceptable contributions showing ingenious solutions of problems in the home, shop, garage, or camp. It doesn't matter if it's wacky—if it works.

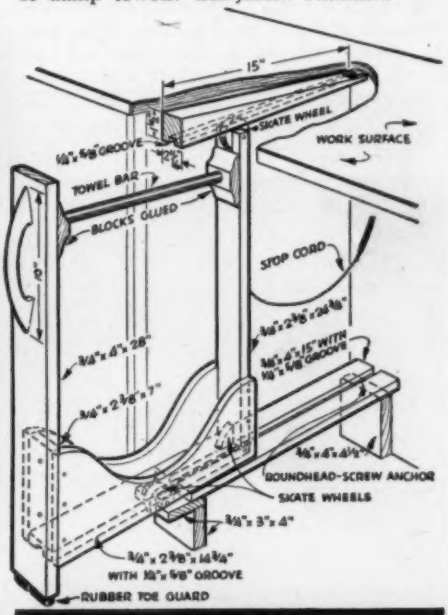
Vanishing Towel Rack

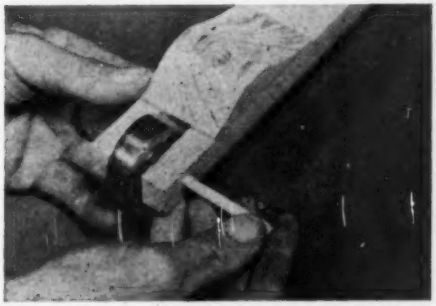
WHEN an old-fashioned kitchen sink is to be modernized by enclosure in a cabinet, it is a good idea to add a built-in towel rack. The one shown is conveniently placed at the right-hand side of the sink to be within easy reach when dishes are to be dried. It rolls out for access either by a gentle pull on the handle or by a nudge with the foot under the raised front. A slight push is sufficient to roll it back out of sight until a towel is needed again.

Ease in operation is provided by three ball-bearing skate wheels. Two of these roll in grooves in inclined guides at top and bottom. The third is fixed in the lower cabinet rail, and the grooved bottom of the rack unit rolls over it. A stop cord attached to a spring halts outward motion before the two lower wheels touch. The raised head of a roundhead screw in the lower groove at the back anchors the wheel there. Be sure not to have the screw head so high that it interferes with easy starting.

The towel bar is set into two bored blocks. It may be a regulation chromium-plated bar, an enameled length of pipe, or a hardwood dowel. If the cabinet frame is left open at the side of the sink and the drawers, air will circulate to aid the drying of damp towels.—BENJAMIN NIELSEN.

Toe operation saves time when the hands are full. The rubber guard prevents scratches on your shoe.

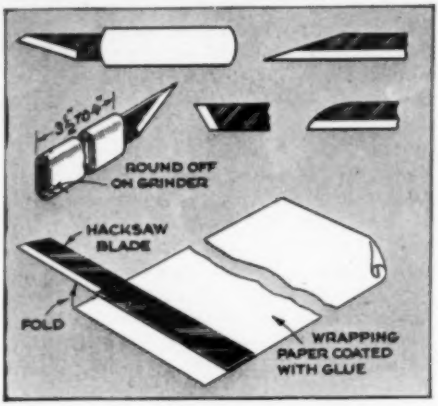




Skate wheels turn on axles cut from a hardwood dowel. Drill rod or bolts are also suitable. This wheel is set in the top of the back upright.

Curved braces nailed into the rack assembly at the bottom hold the unit square. The trough could be utilized for storing boxes and bars of soap.

Paper Handles Give Hacksaw Blades Many Uses



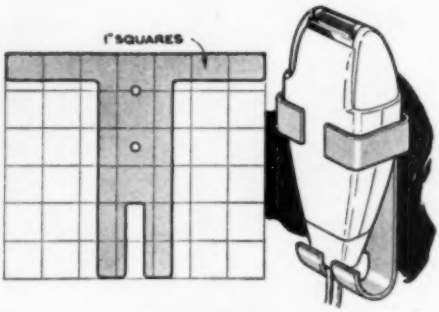
WHILE worn or broken hacksaw blades can be made into high-grade knives, you may have found that trying to punch or drill holes for the handle rivets is a difficult task. However, rolled wrapping-paper handles, varnished or glued on, are an easy and long-lasting substitute.

Grind the teeth off the old blade first and cut to length, allowing 3½" to 4¼" for the handle end. Then grind the blade to shape (some suggested forms are shown at right). Take care in grinding to do the work slowly and cool often, especially at the edge and point.

Cut ordinary brown paper to the width and length required. The latter governs the thickness of the finished handle. Then coat the paper with plastic resin glue and roll tightly on the blade shank. If it is to be a paring knife, which will be washed frequently, use plastic-base varnish instead of glue. Clamp firmly and let it set for about a week, after which it may be shaped to suit your taste on a sander. Finish with a coat or two of varnish.—E. C. LYNCH.

Wrench Grips Hand Grinder

WHEN drill bits and the like are to be sharpened on the wheel of a hand grinder, some means must be found to support the tool so both hands will be left free. One of the new toggle-type wrenches is excellent for the purpose. With the jaws drawn up and locked on the tool neck, it will hold the grinder against light pressure.



Plastic Bracket Holds Shaver

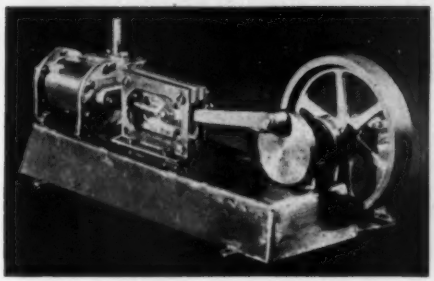
A WALL bracket near the electric outlet and shaving mirror is a convenient holder for an electric shaver. Such a bracket can be made without cemented joints from ⅛" sheet plastic, which can be softened sufficiently for bending in hot water. Be careful to dry the plastic before shaping the arms around the shaver, however, to avoid getting water on the wiring inside. Two holes drilled in the body of the bracket provide for screwing it to the wall.—RONALD EYRICH.

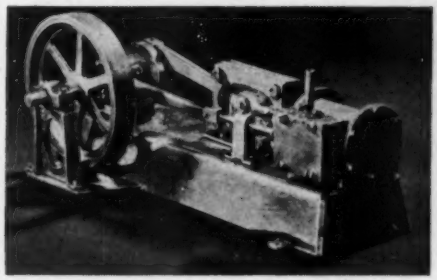
Sticking Metal to Wood

A TRICK that's useful for modelmakers who wish to join metal to wood or celluloid with household cement is to soak the metal in acetone first. Don't touch the cleaned area of metal before cementing.

CRAFTSMEN at WORK

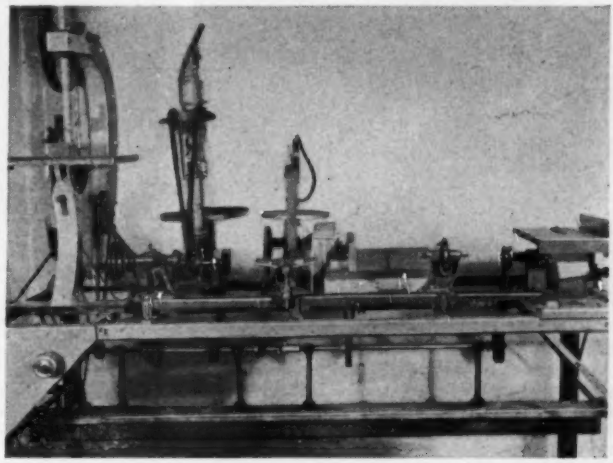
Back-Yard Thrill Ride. Kids—and grownups, too—can get as much or as little shaking around as they like in this caper-cutting carnival ride. The Aerobat, as it is called, rotates end over end or side to side, always under full control of its occupant. Commercial models are to roll along a track as well. Inventor B. B. Pewett, of Oak Ridge, Tenn., is shown taking local youngsters for a ride in a pilot model made of pipe and scrap metal. It is powered by a ½-hp. motor.



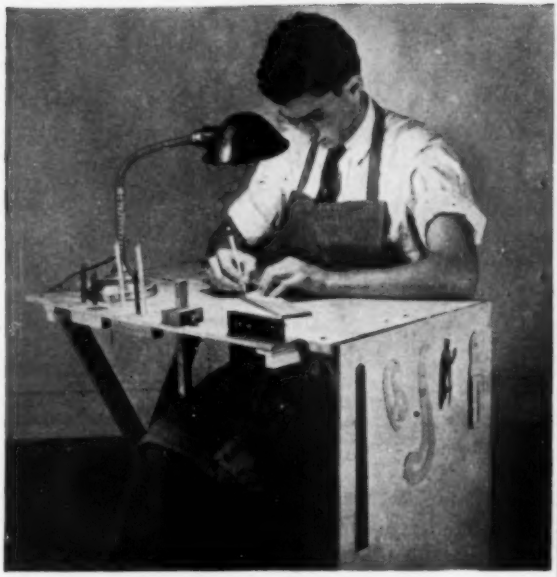


Engine Made of Stock Parts. Neither castings nor a lathe was used by Gordon D. Carlson in the construction of this horizontal, double-acting, slide-valve steam engine. In fact, his only power tool was a homemade drill press used to turn shoulders on the crankshaft and piston rod. Stock sheet, tubing, and rod were used throughout. The model measures 2½" by 3½" by 6". It is the builder's own design, and, while it resembles many big engines, has no actual prototype.

One-Motor Shop. Only a single 1/3-hp. motor is used in W. J. Barr's shop to drive an assortment of power tools. Discarded bed rails, braced and bolted at the corners, make up the bench frame. The motor is directly coupled to a ½" line shaft, which is mounted in hangers made from Ford Model T connecting rods. Minor adjustments of belt tension are made by moving the board on which the jackshaft and driving motor are mounted.



Good Layout Starts the Job Right



UPON proper as well as accurate marking depends much of the success of the finished project. Layout may be scrupulously accurate and yet so sloppily done that the piece will be defaced though the parts fit perfectly. This is particularly true of wood where pencil marks may be so deep that they cannot be removed, but it is also possible on metal where deep scratches cannot be taken out even by persistent polishing.

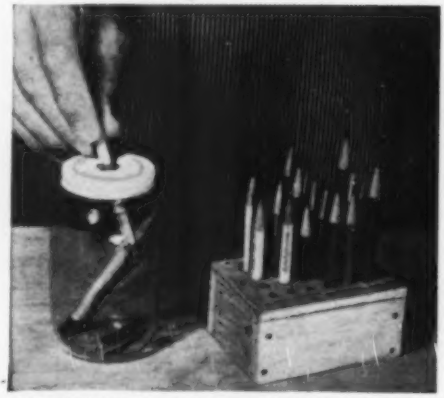
Marking a large number of small parts with the care required by craftsmanship may appear to be a needlessly tedious job; but in the end it will pay by speeding up the work that follows and adding to the project an unmistakable professional look.

If the nature of the work permits, sit down to it. Steadiness is more likely when the wrists and elbows are supported as you sit at the workbench or table.

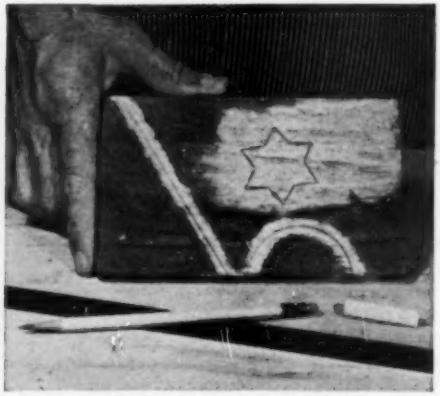
Have all marking implements in good condition and in easy reach. It is a good habit to put the ruler, square, scratch awl, pencils, gauge, punch, patterns, compass, and other instruments in individual slots or stands. Then, after each is used, it is returned to its proper place. In this way there will be no groping for the implement as the layout progresses.

Always work in good light so the marking can be done without eye strain. The lamp should be in such a position that your hand will cast no shadow on the work.

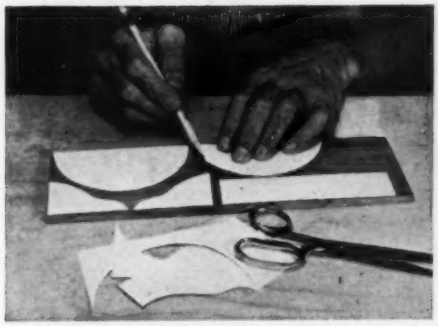
Erase pencil marks before applying finish. Always rub with the grain. If the pencil mark is in a groove, cut the eraser to an edge.—CHARLES and BERTRAM BROWNOLD.



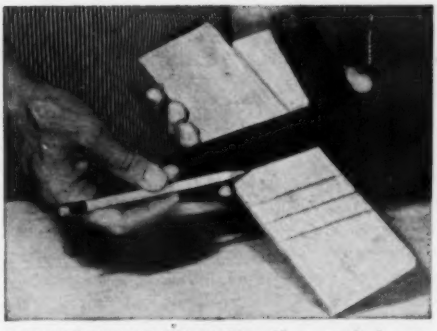
USE PENCILS WITH SHARP POINTS. Put extra sharp points on the pencils you use, and have plenty of them handy. When one becomes dulled, place it in a jar with a hole in the lid to get it out of the way, and then sharpen them over in some spare moment. Use an awl in marking metal.



CHALK BACKGROUNDS ON DARK WOOD. Pencil marks are hard to see on walnut and other dark woods. A useful kink is to chalk the surface to be marked so the lines will stand out clearly. Never make the lines too long on any wood; it only makes more to rub out after cutting.



PATTERNS AID ACCURACY. Except for layouts that can be made with a straightedge or compass, don't make them directly on the work. It is far better to try them first on paper, and then to transfer them to stiff cardboard or even light metal. Such patterns are a help also in figuring how to get the most out of a given piece.



HOW TO REPEAT AN ANGLE. If an angle has to be made a number of times on work, make a wedge of the required taper and hold it between the work and the square when marking. For 30-, 45-, and 60-deg. angles, artist's triangles can be used. Marks can be made close to the square if the pencil point is long and tapered.

PREVENTING COMPASS-POINT DIG. A sliver of wood taped on the work under the compass point will keep it from making a deep hole.

BLUNT CENTERPUNCH WON'T SPLIT WOOD. If you use a blunt punch it straddles the fibers and locates a mark more precisely than a sharp punch.

HOLD PATTERNS WITH ADHESIVE. To prevent the slipping of a template while marking, hold it to the work with bits of adhesive tape.

MAKING A REPEATING PATTERN. Cut a template to the shape of one repeat part of the pattern and move it along as often as necessary.

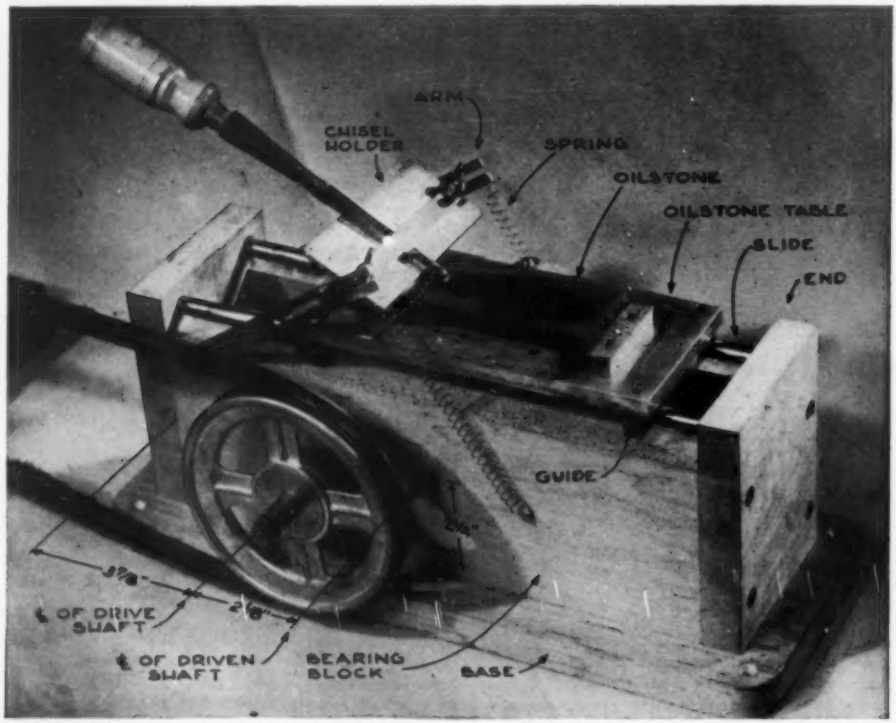
Power Oilstone Ends Sharpening Chores

THIS may seem like a luxury for the home workshop, but once you've tried a power whetstone that works while you do some other job, you'll never be without one. Because its patience is inexhaustible, it will continue sharpening a chisel or plane iron long after you would have given up, and it will produce an edge the like of which you've probably never used before. In fact, the edge will be so keen you better watch your fingers the first time you try it.

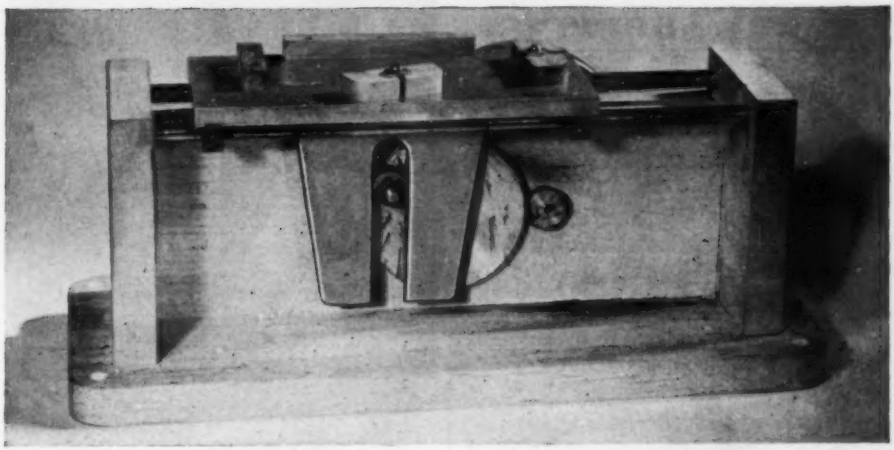
The stone is moved back and forth under the chisel by a motor-driven pulley operating two gears. A ball bearing mounted on the second gear travels in a slotted brass yoke screwed to the oilstone table, which is held on two drill-rod slides by two drilled brass guides. With a 1" pulley on a 1,750 r.p.m. motor and a 4" pulley on the sharpener, the speed will be about right. If the yoke bearing is bolted near the edge of the large gear, travel of the oilstone table will be about 2¾". Experiment by relocating the bearing nearer the center if vibration is troublesome.

Make the table of a ⅜" aluminum plate and the stops, clamps, and stand of hardwood. The base, ends, and front cover may be ¾" stock, but the bearing block should be 1¾". Bore it 5/16" for ¼" drill-rod shafts, and counterbore both sides for a press fit for the four ¾" o.d. ball bearings.

Make up the tool holder as shown in the drawing, and assemble on the pivoted brass arms by means of the end-threaded rod and wing nuts. The two springs should be strong enough to hold the chisel evenly against the oilstone. Pack the five ball bear-



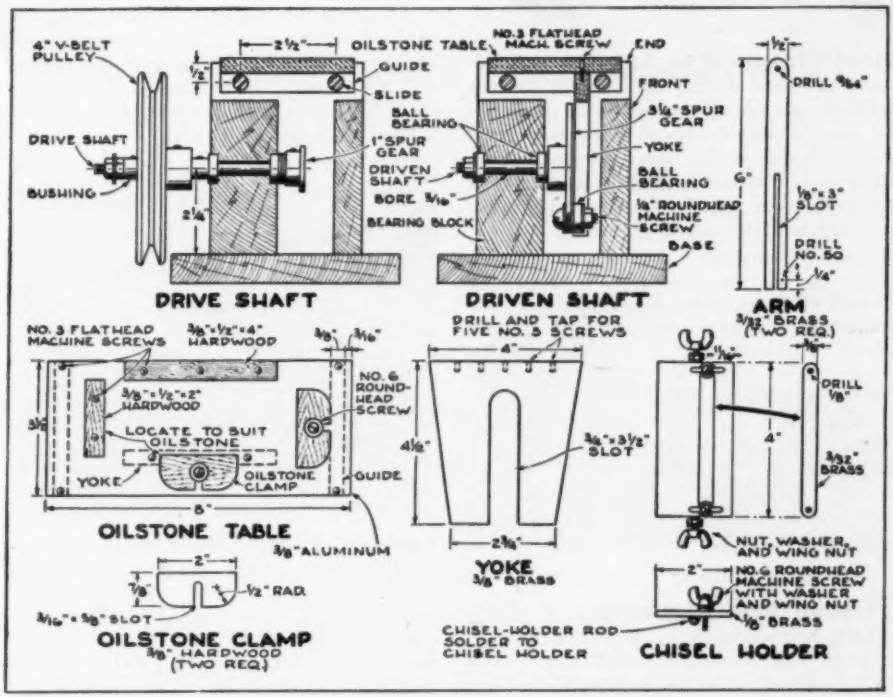
Drill the shaft hole for the 3¼" gear at the center of the block. Check gear mesh and lay out the other.



Movement of a ball bearing in a yoke operates the stone table. The bearing fits the slot without play.

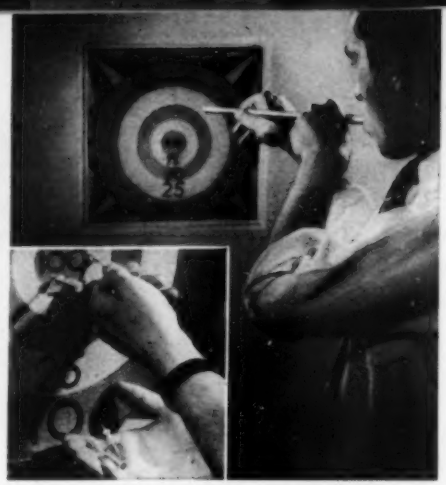
ings with cup grease and spread a tough, fibrous grease in the yoke slot.

A badly nicked chisel must be ground first on a wheel in the usual manner. It is then clamped in the holder carefully to get the bevel flat, and the machine is started. Use a medium oilstone first and finish by setting a hard Arkansas stone on the table and readjusting the chisel. After a perfect edge has been put on the bevel, a few strokes are taken by hand on the flat side to remove the feather edge.—HERBERT PFISTER.

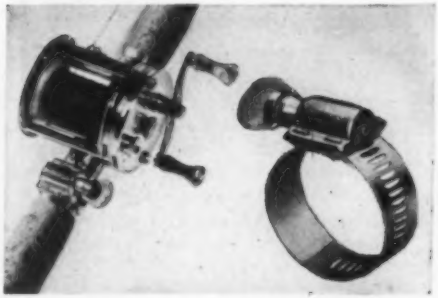


Few dimensions are critical. Adaptations may be made in most parts if substitute materials are on hand.

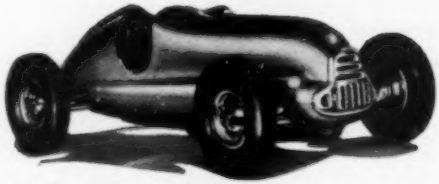
HOBBY SHOPPING



Dart Game Uses Blowgun. With a new dart game invented and put on the market by William L. Kline, of New York City, you use a blowgun instead of your arm to send the dart into the target. The 28″ gun is made of aluminum alloy and the darts of aluminum with steel tips. Fair accuracy up to 50′ is said to be obtained with the gun. Selling for $2, the game consists of two blowguns, two removable plastic mouthpieces, four darts, and a 14″ by 14″ cork target, all packaged in a carrying case.

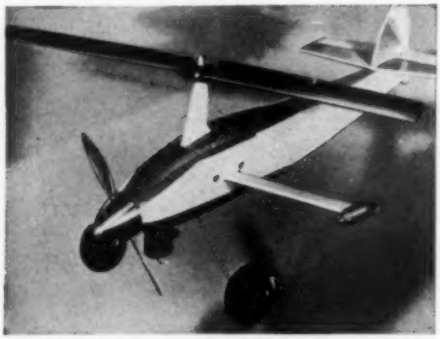


Reel Clamped to Any Rod. Originally designed during the war for various military uses, the Aero-Seal clamp produced by the Aircraft Standard Parts Company, Inc., of Rockford, Ill., now has been adapted for use of fishermen. Easily tightened with a thumbscrew, the stainless-steel clamp may be used to fasten a reel to any rod.



Model Car Is Light. Designed for either cable or track racing, a new 17″ model car produced by Reuhl Products, Inc., of Madison, Wis., has a fiberglas body and weighs only 3 lb., 14 oz. without engine and accessories. It features a front drive with 2-to-1 bevel gears in oil. Packaged in a kit, it sells for about $25.

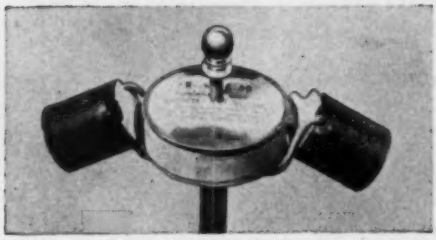
Radial Engine. A model five-cylinder airplane engine that is a scale replica of the Le-Blond engine is being produced by the Burgess Battery Company, of Chicago. The parent engine is 33¼″ in diameter, weighs 219 lb., and develops 85 hp. The model is 5⅜″ in diameter, weighs 22 oz., and develops ⅛ hp.



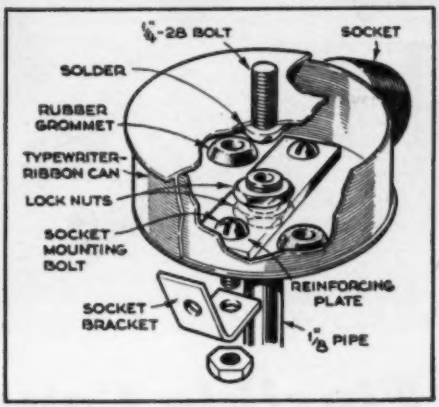
Control-Line Autogiro. A model Autogiro produced by the Engineering Development Company, Del Mar, Calif., is designed for control-line flying. Built for any engine from .232 to .600 cu.in. displacement, it descends gently when the motor is cut, like the real thing. The plane is 27″ long, with 25″ rotor blades.

Fishing Bob Lights Up. A plastic fishing bob made by the S & H Mfg. Co., Russell, Kan., contains a small battery and bulb, both of which are replaceable. When a fish bites, a mercury switch flashes the bulb.

The canopy is the base, plastic tubing raises the glass body, and a brass tube carries the socket.



Common lock nuts secure the typewriter-ribbon can to the stem. A bolt takes the shade and finial.

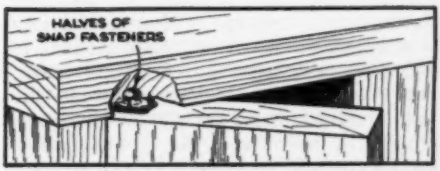


Junked Lighting Fixture Provides Lamp Parts

An old overhead lighting fixture may yield numerous items of value to the craftsman who likes to build floor and table lamps. In addition to running-thread pipe (there was a 14″ length in the old fixture used here) he may find a spun or stamped canopy, sockets, tubing, and perhaps an ornamental glass body drilled for a pipe.

Such a body, plus the canopy, a 3½″ length of 1¼″ plastic tubing, a length of ⅛″ pipe, and a short piece of brass tubing, comprises the lamp shown. What was the canopy of the fixture (placed against the ceiling) forms the base of the lamp.

The sockets were switchless, but each had a small angle bracket by which it could be mounted in a two-bulb cluster on a typewriter-ribbon can. Leads were run through grommets into the can, and control was provided by a switch set in the lamp base.

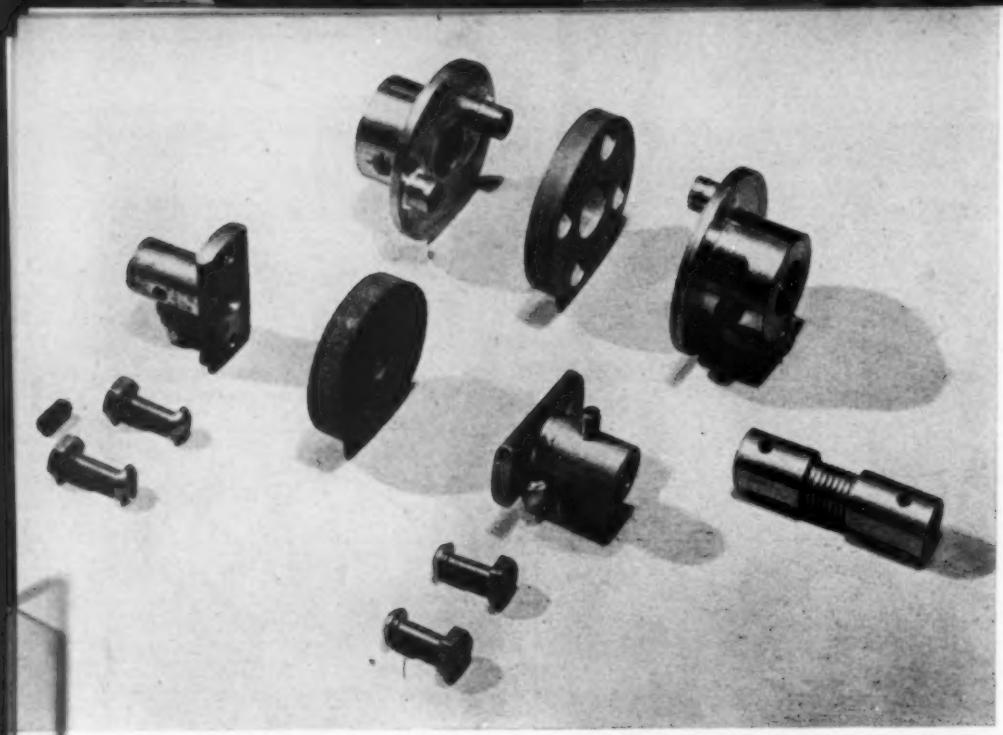


Snap Fasteners Make Hinges

Concealed pivot hinges for doors on small craftwork projects may be simply a pair of snap fasteners. Align carefully, and then recess and cement half of each fastener in the frame and half in the door before final assembly is made.

Ball Protects Flashlight Lens

Kept in a serviceman's or handy man's tool chest, a flashlight won't be damaged if the lens is protected by a hollow rubber ball. A circular section cut from the ball with scissors should be just large enough for the ball to fit the barrel snugly.



Three types of flexible coupling are seen here. Two use a flexible disk, the third (right) a coil spring.

Flexible Couplings Smooth Power Flow

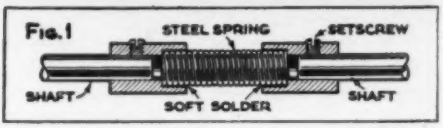
WHEN two shafts meet end to end, a flexible coupling of some sort usually is needed to compensate for unavoidable misalignment. By bending or giving a little, such a coupling will transmit rotary power smoothly from one shaft to the other. Furthermore, a flexible coupling absorbs much of the starting shock when power is applied, thereby protecting the parts of the mechanism. It also lessens noise and prevents vibration from passing between the shafts. Sometimes a coupling of this type is used as an insulator in electrical control equipment, or it may perform the functions of a universal joint, the misalignment of the shafts being intentional.

Flexible couplings of many types are successfully used. A few are described here to suggest possible designs that may fit your shop requirements or mechanisms that you may want to build.

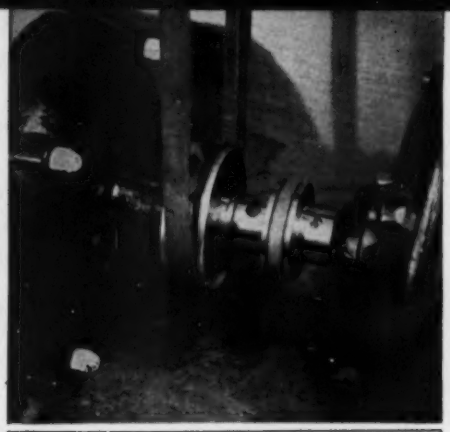
Perhaps one of the simplest is a crude type of universal joint often encountered on toy boats. Paradoxically, this coupling involves no actual linkage between the shafts. The end of each shaft is simply bent to about 35 deg., the bent ends touching to transmit rotation and sliding on each other to take up any unevenness.

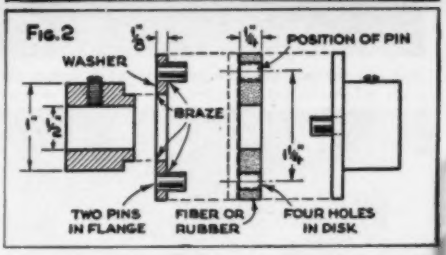
Figure 1 shows another simple arrangement that is useful where you want some flexibility and also a cushioning action in starting and stopping. A short coil spring is soft-soldered into two collars secured to the shafts with setscrews. For light drives, the spring can be soldered right on the shafts. Since there are no moving parts other than the turns of the spring, there is nothing to wear or require lubrication, but a steel spring should be oiled to prevent rust. It is usually possible, of course, to make this and other types of couplings to join shafts of different diameters.

A coupling arrangement that is frequently used consists of a disk of rubber, leather, fiber, or some similar material mounted be-



Closely wound springs are good for absorbing shock as power starts or stops. In the photo above, one is being installed between a motor and shaft.





Joined by a disk coupling, two ¼-hp. motors in the photo above deliver nearly ½ hp. The drawing gives dimensions for a disk coupling to fit a ½" shaft.

tween two plates fastened to the shaft ends, the disk having four or six holes to receive pins attached to the plates. Figure 2 shows how you may build up the end plate for such a coupling from a large washer, a piece of steel machined to fit the shaft end and the washer bore, and two short steel pins. The parts are brazed or silver-soldered.

If you want considerable cushioning action, the disk should be cut from resilient rubber, preferably reinforced with fabric. A piece of rubber belting will serve nicely. If less cushioning is needed, the disk may be made from some material such as leather, formica, or fiber. It must be thick enough so that the pins from one plate do not extend through to touch the other plate.

A popular variation of the disk idea makes use of a flexible member and two metal "spiders" attached to it and the shafts. A coupling of this type may be seen in the pull-apart photo on the facing page and also in the photo at the top of page 190.

Each end piece, or spider, consists of a flat, rectangular piece of steel brazed to a sleeve to form a T. Near each end of the flat strip is a hole for bolting or riveting it to the disk. The two spiders are positioned so their flat T-heads are 90 deg. apart. There should be no metal-to-metal contact. Instead of the flat strips, curved U-shaped yokes might be used for the end pieces, especially if the coupling is large or subjected to considerable angular deflection. Disks may be cut from flat rubber belting, leather, or similar material.

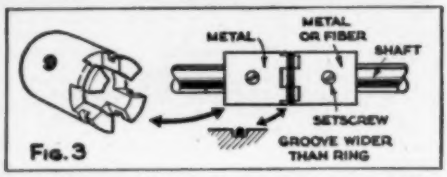
When the disk is a nonconductor, such a coupling will serve as an insulating unit in the shafts of radio or other electrical equipment. Couplings with flexible members made of resin-impregnated fabric or other insulating material are available at many radio supply stores. These are designed for ganging condensers.

Interlocking castellated members form the coupling illustrated in Fig. 3. The two sections may be machined from steel, brass, fiber, or plastic—depending on the strength desired—or one might be of metal and the other of fiber or plastic. The notches should be machined so there is slight clearance between them and the matching fingers; the more clearance, the more flexible the coupling. Graphited grease applied as a lubricant will reduce noise. This may be retained by placing a short tube of oil-resisting synthetic rubber or similar flexible material around the coupling.

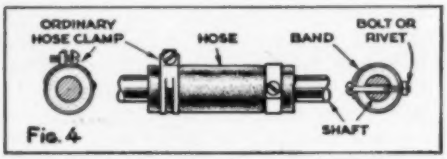
If the shafts are mounted with negligible end play, the sections will remain inter-

In this coupling, each end consists of a sleeve with a piece of flat stock brazed on in the form of a T.

One of the simplest couplings is a piece of rubber hose clamped to the shafts. Here such a coupling is used to join two shafts of different diameters.



Interlocking teeth transmit power from one shaft to the other in this coupling. Clearance between the interlocking members provides flexibility.



Two methods of attaching a hose coupling are shown here. With an ordinary hose clamp, the hose may be bonded to the shaft with cement to avoid slippage.

locked without any special fastener. The drawing, however, shows a wire ring resting in a shallow groove cut around the interlocking fingers, the groove being wider than the ring to permit slight angular movement of the coupling.

A coupling of similar type sometimes is improvised from two bevel gears, the gears being mounted so their teeth interlock to transmit the power.

Another common type of coupling—and one of the simplest—is merely a short length of rubber hose clamped over the ends of the shafts. Figure 4 shows just two possible ways of anchoring such a coupling positively. One involves drilling small holes through a metal band, the hose, and shaft to receive a bolt or rivet. The other is simply a conventional hose clamp. These clamps are satisfactory if there is no danger that projecting parts of the clamps will strike something, and if friction alone between the rubber and shafts is sufficient to prevent slipping. If you wish, the hose may be cemented to the shafts or to two metal sleeves that in turn are fastened to the shafts. Commercial couplings of this type come equipped with setscrews that do not project above the surface of the metal ends.

No matter what type of coupling you use, or where you use it, every effort should be made to line up the coupled sections as closely as possible, for the less work the coupling has to do the quieter it will run, and the less heat developed in its flexible or friction members the longer the coupling will last. Rubber coupling parts should be protected from oil and grease unless they are made of oil-resisting synthetic rubber.—W. A. Conway and W. E. Burton.

How to Make Rotary Files

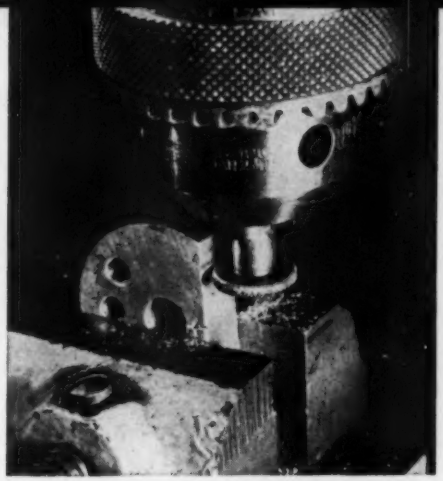
THESE little tools, so much like dental burrs in appearance and operation, are as easy to make in the home workshop as they are handy to use on metal, wood, and plastics. They can be driven by a hand grinder, electric drill, drill press, lathe, or milling machine.

Turn the blanks to shape for a set such as shown below, and file and sand smooth. A is a ball point. The cone B can be used as a countersink if the angle is suitable. *C* is for undercutting. One of the handiest shapes is the cylindrical *D*. For cleaning out grooves and the like, E will be found excellent. *F* may be used for both concave and convex cuts.

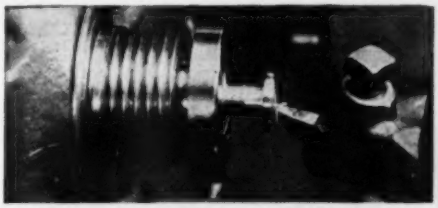
Perhaps the most useful shank is ¼" in diameter, suitable for both drill press and electric drill. A 1/8" shank will fit many small hand grinders, while a ⅛" shank is good for large files and rasps and for countersinks, edging cutters, and the like used in a collet or setscrew chuck in a drill press or milling machine.

Clamp the blank to cut the teeth. A wood- or metal-block backing covered with lead, aluminum, copper, or fiber will prevent bending the shank while cutting. Use a slender, sharp chisel and a hammer. Some file cutters grind the chisel to taper to a very sharp edge with no distinct bevel. A magnifying glass is needed when making the smallest files.

The blanks may be of drill rod or tool steel. After cutting the teeth, heat cherry red and quench in water or oil. Tempering isn't necessary, though you may wish to anneal the shank.—W. E. BURTON.

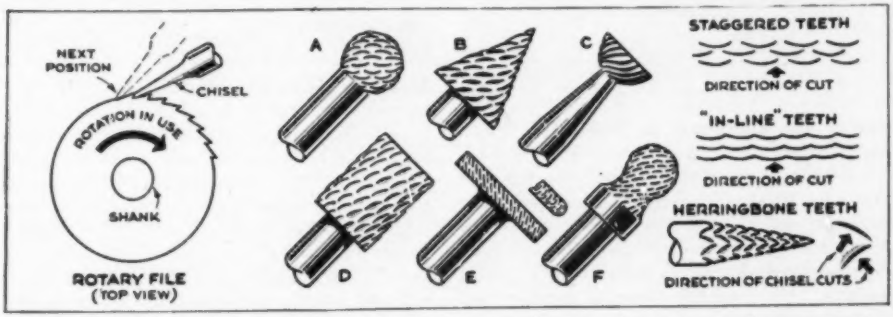


In a drill press, rotary files will shape cavities, burr or enlarge holes, and do many smoothing jobs.



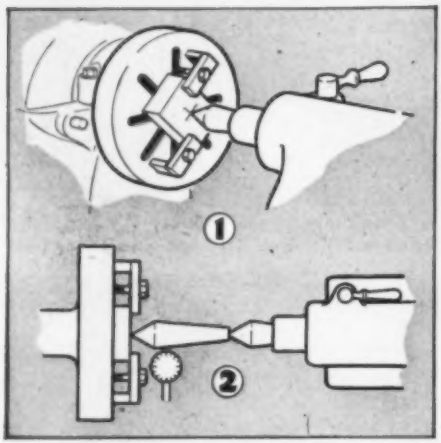
Blanks are shaped with the heads slightly smaller than required for the finished "working" diameter.

Cutting teeth enlarges the blank. If some sizes must be exact, experiment by making others first.



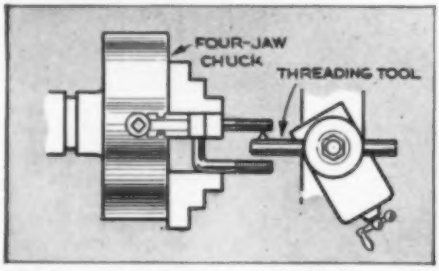
Space each tooth by resting the chisel on the back of the preceding one. Above, three tooth arrangements.

NEW SHOP IDEAS

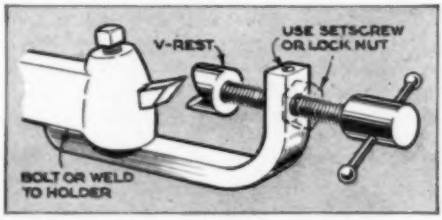


Centering a Faceplate Job. By this method, a faceplate job may be set up to a center punch mark without a wobbler. The work is first held against the faceplate with the dead center, Fig. 1, in approximate position for clamping. For truing, slide back the tailstock and use the live center and an indicator, Fig. 2. In a pinch, a paper feeler between the tool holder and center will substitute for an indicator.

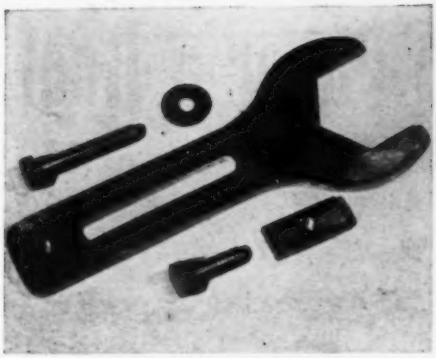
Brush Keeps Drill Clear. There is no need to waste time blowing away chips while drilling several holes close together in a single piece of work if you wire or tape a few bristles from an old floor or paint brush on the drill. Place the bristles a little above the end of the drill, as in the photo above, to prevent obstructing the view when centering the drill for the next hole to be drilled.—WILBER H. FULKER.



How to Thread a U-Bolt. When the problem came up of rethreading a U-bolt for which no die was available, the job was done as illustrated here. The U-bolt was clamped in a four-jaw chuck while the threading tool was held in a boring bar. Threading then was carried out in the usual manner. For lack of space, a regular tool holder could not be used.—R. M. DYKE.

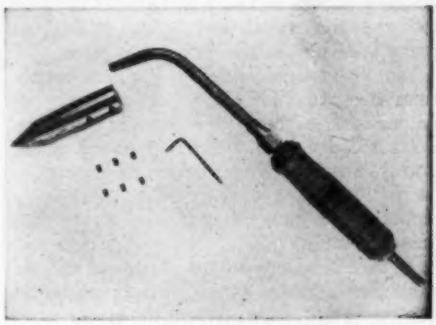


V-Rest Keeps Work Rigid. Attached permanently to a standard tool holder, this improvised follower rest will keep long, spindly work in proper contact with the cutting tool. The center of the screw, the bottom of the V-notch, and the cutting edge of the tool should all be aligned at lathe center height. The V-rest, which is free to pivot, is machined from brass. If made sufficiently large, one rest will accommodate most sizes of work.—D. BISCEGLIA.



Work Holder Aids Drilling. An open-end wrench about 6″ long and 3/16″ thick may be quickly converted into a drill-press hold-down that will be particularly handy for thin, flat work. Drill and file a 9/32″ slot for the hold-down bolt, and drill and tap a hole ¾″-20 for an elevating bolt. The hold-down bolt is fitted with a special rectangular nut made of ¼″ stock and also drilled and tapped ¾″-20. This nut is slipped through one of the table slots, turned crosswise, and then tightened.—WILL THOMAS.

Soldering Tip Fits Torch. You may extend the usefulness of a small acetylene or gas torch by equipping it with a tip for heavy soldering. Copper is best for such a tip, but iron or steel also may be used if properly tinned. Drilled so that it is hollow almost to the point, the tip slips over the torch head and is held in place by six set-screws. Angled to keep escaping flame away from the tip, three exhaust ports are drilled into the flame chamber just ahead of the end of the torch. The tip is quickly removed when a flame is wanted.—H. L. PHILLIPS.



COATED ABRASIVES, II [SHOP METHODS]

Abrasive	Work	Properties	Grades	Form
Aluminum oxide	General metal working and finishing, hardwoods, floors	Sharp, tough, nonmagnetic—good for burnishing when dulled	400 (10/0) to 12 (4½)	Belts, rolls, disks, sheets
Silicon carbide	Soft metals, paint, plastics, glass, leather, wood, floors	Hard, fragile, nonmagnetic—stays sharp when crystals break off	400 (10/0) to 12 (4½)	Belts, rolls, disks, sheets
Garnet	Woodworking, plastics	Sharp, fragile	8/0 to 3½	Drum covers, belts, rolls, disks, sheets
Flint	Household use, paint, carpenter work, sanding commutators	Not so sharp as garnet	5/0 to 3	Rolls, sheets
Emery	Metal polishing	Medium hard, medium sharp, magnetic	3/0 to 3	Rolls, sheets
Crocus	Fine metal polishing	Extrafine grit		Sheets

Some common trade names:

Aluminum oxide—Abrasite, Adalox, Adamite, Alabrase, Alorix, Al-Ox, Aloxite, Alundum, Ansandum, Ansolox, A-O-66, Baco, Boxite, Carbalox, Durexalo, Durexite, Durundum, Electric-Abrasive, Garalun, Jewelox, Luminox, Lumnite, Metalite, New Process, Production, Three-M-ite, Usalox, Wausite, Yellow-Stripe.

Silicon carbide—Amunite, Ansilicon, Armourite, Blue-Stripe, Carbicon, Carbonite, Carborix, Carborundum, Crystolon, Crystox, Durexsil, Durite, Herculundum, Jewelite, Sil-Carb, Tri-M-ite, Vulcanite.

POPULAR SCIENCE MONTHLY SHOP DATA

How to Paper a Roof

Tackle the work before a leak actually shows up; then, if properly done, the job will last for years.

By Harold R. Terpeny

WHEN a tar-papered roof begins to leak, that's one definite sign it needs immediate repapering. If allowed to go on, leaks will stain ceilings and wallpaper and in time will soften plaster, weaken the clinch, and cause the ceiling to crack, sag, and perhaps fall. Continued dampness also eventually rots the sheathing under the roofing material and may even damage the rafters.

But you don't need to wait until a leak actually occurs to tell that repapering is in order. If the smooth surface looks flaky and fuzzy, the life of the paper has gone and it should be replaced. This happens earlier than necessary in many cases because of neglect. The third year after a roof has been laid, it should be coated with asphalt, and then recoated each succeeding year.

If the old paper is still solid and fairly smooth, you may repaper over it, but this is not recommended. It is really better to strip off the old paper and take out the old nails first. Many expert roofers prefer to use paper 18″ wide. When the paper gives with the alternate expansion and shrinkage of the wood sheathing to which it is attached, there is a great deal of wrinkling. These wrinkles can't harm the roof, but they are much smaller on 18″ paper than on 36″ widths and are less noticeable from the ground. Figure 1 shows a simple method of cutting 36″ paper if the narrower width is not available. The line is gauged with a nail driven in a homemade T-square and is cut with a linoleum knife.

Lay the paper from the lower edge of the roof up, overlapping each piece 2″. Start flush with the bottom and gable edges, as in Fig. 2, and nail (at 6″ intervals) only in the upper margin, which will be covered. (Direct sun heats the paper tremendously, expanding it and causing exposed nails to loosen a little each season.) Cement the paper flush with both edges of the roof, using good roofing cement along a 3″ band, and cement also the overlap of each succeeding piece. Some roofers bend paper over the edges instead of trimming it flush, but in such cases the stiff paper frequently pulls away before the cement can set, the edge of the wood can't be completely coated with paint, and moisture creeps in. Cement itself is a good waterproofer and produces a tight joint when paper is trimmed flush.

When flashing is reached, as at the upper edge of a porch roof (Fig. 3), trim the strip if necessary to required width; then turn up the flashing, nail the paper down, apply cement, and press the flashing onto the cement. Take care not to smear the cement here or at the overlaps, where it will show. Flashing should be sheet copper or lead, but failing these the roofing paper itself can be used.

At a hip, cut the paper flush and nail it along the hip. Then gauge a line on each side, as indicated in Fig. 4, and cement on a 9″ wide covering strip of paper. No nails and no covering strips are used in valleys (Fig. 5). Instead, the paper is brought up to the center of the valley, trimmed, and fastened to the flashing with a thick coating of cement. If new flashing is needed, apply a 12″ wide strip.

Finishing at the ridge is similar to that at hips, as shown in Fig. 6. Trim the last strip of roofing paper on each side flush with the top, gauge a line on each side 3″ down, and nail within the margin. Then apply cement, and press a 6″ wide covering strip firmly into it.

Have no qualms about the sticking qualities of good roofing cement. It will hold, if the job is otherwise done properly, even in the strongest winds. In using the cement, fasten a 6′ length of the paper at a time, press the paper down, and then do another 6′ length. Complete one piece of paper before starting on the next. Covering strips at the ridge and hips are cemented similarly. Finish one complete side of the ridge first, and then do the other.

Fig. 1

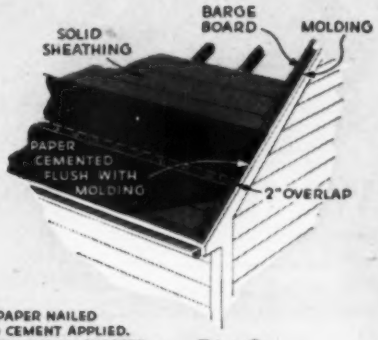


Fig. 2

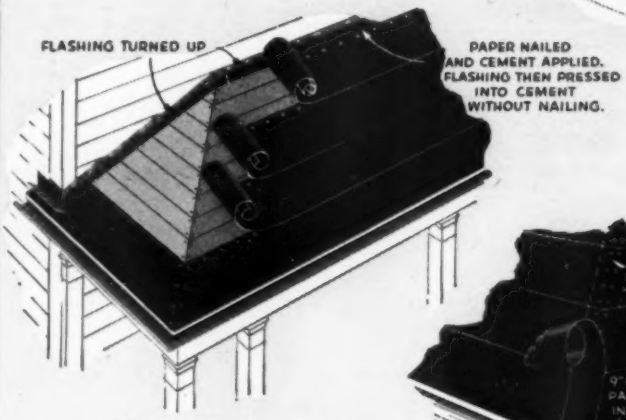


Fig. 3

Fig. 4

Fig. 5

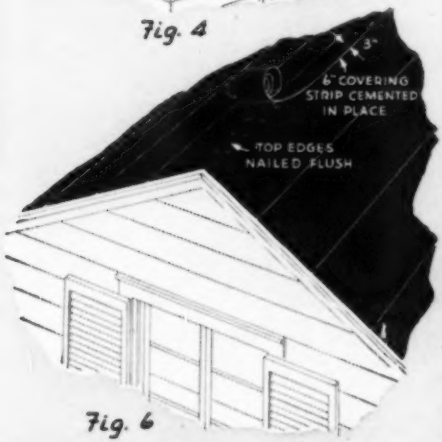
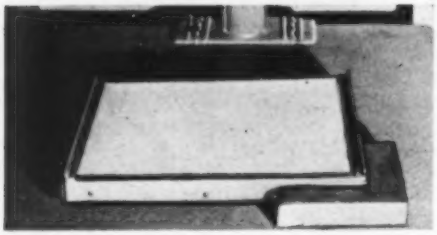
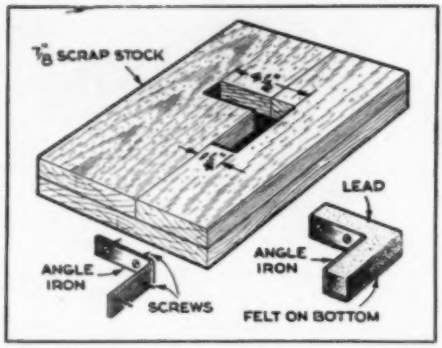


Fig. 6

sigman-waad

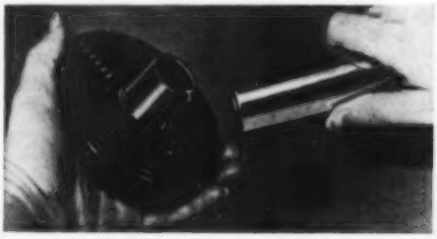
PHOTO IDEAS and EQUIPMENT





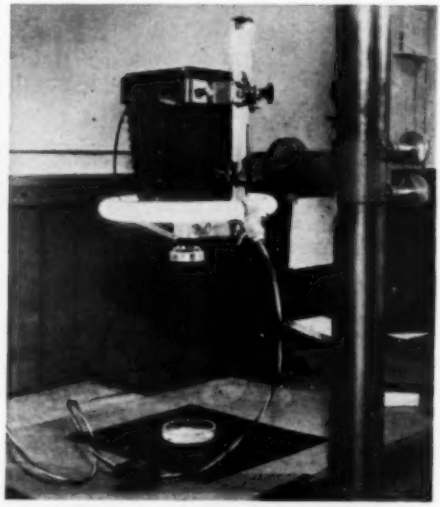
Place the angle iron and screws in a form made of three pieces of wood, and pour in molten lead. Glue felt to the bottom of the finished weight.

Block Locates Easel. In enlarging, this weighted angle block is almost as good as an extra hand. After spotting the easel and pushing the block against a corner, you can remove the easel to load it with paper, and put it back in the original place. The weight is made by placing screws in a metal corner angle, setting this in a wood form, and pouring in molten lead. Paint it dull black.—James A. Richards.



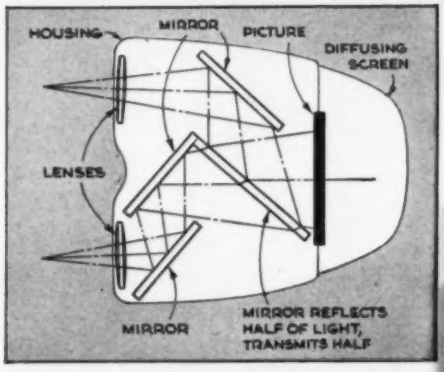
Cleaner Dries Reel. The reel of a roll-film developing tank may be quickly dried with a vacuum cleaner of the type that has a blower connection. Just attach the hose to the blowing end and let the air do the job.—R. F. Donovan.

Doctoring a Negative. If a bottle of opaquing solution is not at hand when you want to cover a pinhole or other blemish in a negative, a little Mercurochrome may be used in its place. Apply it to the spot with a small soft brush drawn to a point.

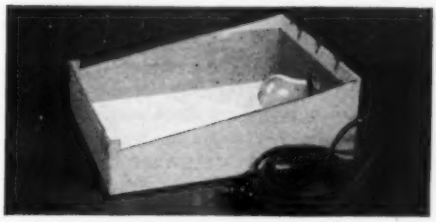


Fluorescent Lighting. A 12" circular fluorescent lamp provides flat, even lighting for photographing small objects or copying work. In addition, its high actinic value keeps exposures short. With most 4" by 5" cameras, no special clamp is required to hold the lamp while the camera is in a vertical position. By compressing the extended bellows slightly, the lamp may be slipped over the front. For other cameras, tape or wire clips might be used to keep the lamp in place.—G. Dexter Herndon.

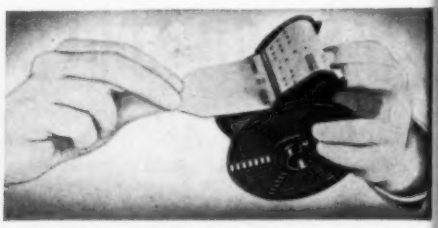
Lights Move with Camera. An attachment made by A. L. Bensen & Co., of Staten Island, N. Y., provides easy portability of both camera and lighting for indoor movie making. In addition to a metal arm that supports two reflector photofloods above the camera, the attachment includes a handle with a threaded stem that passes through the arm into the camera tripod hole. It also may be used with still cameras.



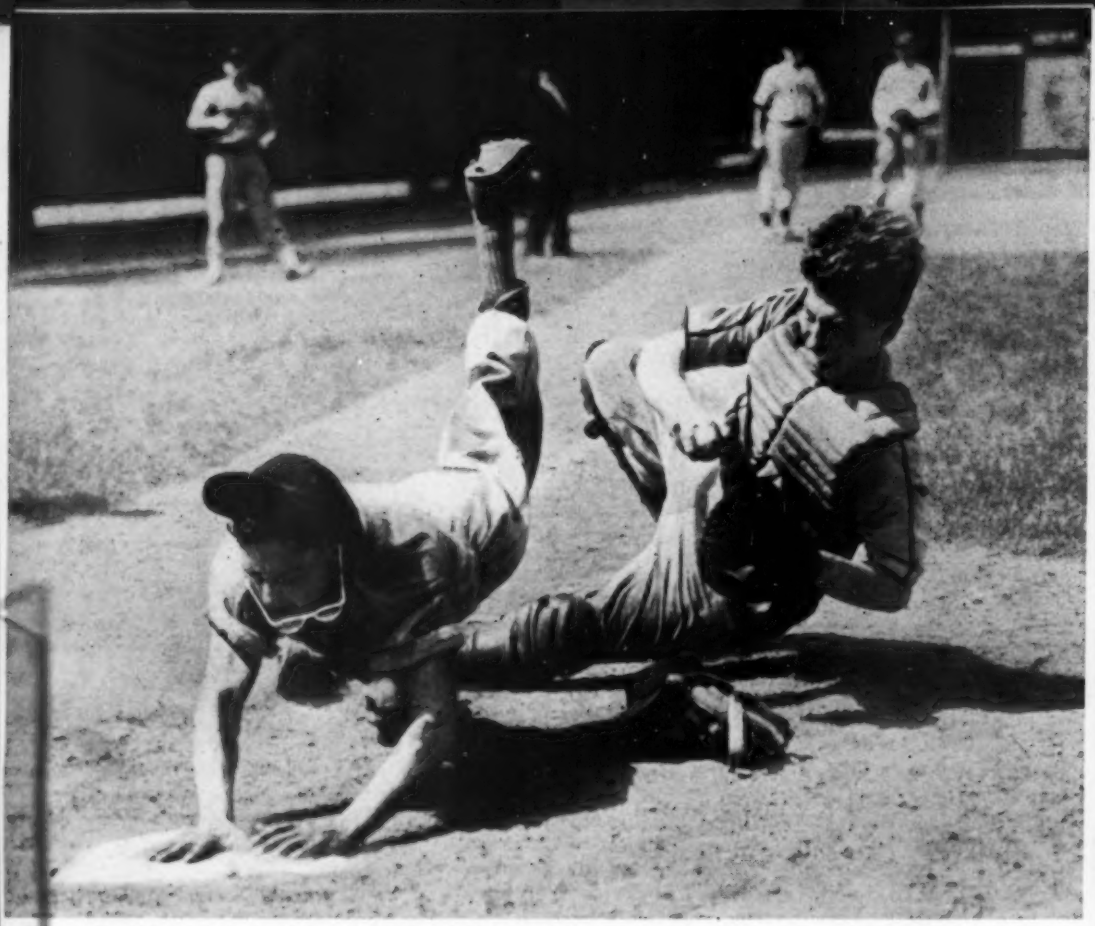
Gives Third Dimension. A new viewer for 2″ by 2″ transparencies produces the effect of a third dimension with only one picture. This is accomplished by use of an optical system that carries the image to both eyes, making it unnecessary for the user to close one eye as with most viewers. Selling for about $12.50, this viewer is manufactured by the Craftsmen's Guild, of Hollywood, Calif.



Retouching Stand. A strong cardboard box cut as above provides the base for an inexpensive retouching stand and viewer. Place white paper on the inside bottom surface to reflect light, and a sheet of ground or opal glass on top. A 15-watt lamp will do for retouching, but a 50-watt bulb is better for viewing. Cut masks to exclude light from all but the working or viewing area of the glass.—KENNETH S. JOHNSON.



Film Loaded with Ease. A loading device made by the Airequipt Mfg. Co., Inc., of Mount Vernon, N. Y., makes it possible to thread a roll of exposed film on a developing-tank reel without touching the film. The roll of film is inserted in the loader, the latter is placed at the proper position on the reel, and as the protective paper covering is pulled, the film automatically slides into the grooves of the reel.



"Old School Try" by Jack Frank of the New York Herald Tribune shows the action you can find in sand-lot and school baseball. First prize winner in a New York show, it was taken from 20' at 1/1,000 sec. at f/8.

Focus on Sports

By Murray L. Becker

Chief Photographer, The Associated Press

EVER wonder whether you could make sports action photos like those in your newspapers? With average amateur equipment, there's no reason you can't. Besides adding some interesting pictures to your own collection, you may find your local editor willing to buy a few of the best.

While covering sports, press photographers ordinarily use cameras with a shutter speed of 1/1,000 sec., but the lack of such equipment need not deter you. Even if your top is only 1/150 or 1/200 sec., you can freeze a lot of movement by shooting head-on or at a 45-deg. angle—or you can pan with the action as it sweeps by. The professionals who produce the photos you see on the sports pages use both methods.

An eye-level camera is best for most sports, for you can see what is going on around you while keeping the area of probable action within the finder. Fast film should be used, and a lens shade is an excellent idea. You can avoid missing a lot of shots by using a focusing footage scale instead of a rangefinder. If your camera does not have a footage scale, make one by placing permanent markers on the camera bed (if it is that type) for various common distances. This will permit a quick change of focus for any desired shot.

Sports action never waits. Because of this,

Ring lights make it possible to shoot fights without flash. At the ringside, 1/150 sec. at f/4.5 on fast film will give excellent results. Good shots also can sometimes be made from a close-in spectator's seat.

you should know your camera so well that you almost could operate it in your sleep. You also must know the game you are covering. In fact, a topnotch sports photographer practically plays the game, anticipating what the next play will be and getting set to catch it exactly the right split second.

In this connection, it should be noted that in some sports there are split seconds where the fast action hesitates. For instance, a pole vaulter shooting up over the bar hangs suspended for the merest fraction of a second before starting his fall. Even a slow shutter speed at exactly that moment would keep your vaulter there for eternity—in a photograph. Another point to remember in stopping action is that the closer you are the faster shutter speed you must use to avoid a blurry result.

Before setting out for the ball game with camera in hand, there are a few other points you should consider. At many of the larger sports events, photographers must get special credentials and abide by certain rules. Because of this, major league baseball offers little opportunity for the amateur. At such games, press photographers generally work from the press box, shooting with a "Big Bertha" (28″ to 40″ lens) for closeup action. Even if the amateur could afford such equipment, it is doubtful whether he could get permission to work in the already overcrowded press box. The same situation goes for work down on the field.

At sand-lot and most amateur contests, however, you can shoot right from the side lines, and the pictures that result often will equal anything that might be taken at the pro game. Football, basketball, the fights, tennis, horse races, and various winter sports

Synchronized flash brings basketball shots within the range of the amateur. This well-lighted flash picture was taken from a spectator's seat in the front row. At a distance of about 30', one peanut bulb usually will yield a well exposed negative.

In football, the photographer must anticipate the play so that he can shoot at precisely the right moment. Here, as in most other sports, a footage focusing scale will help you get many pictures.

also abound in good action that the amateur can get.

In photographing baseball from the side lines, the eye-level camera is especially desirable. One trick I learned when trying to catch a runner attempting to beat the throw-in is to shoot a fraction of a second before he completes his slide. In other words, shoot while he is still in the air. The camera shutter is fast, but there is always a lag in its operation. That time lag makes the difference in what the eye sees and the camera registers. Thus we get a split-second action shot that shows the runner either safe or out.

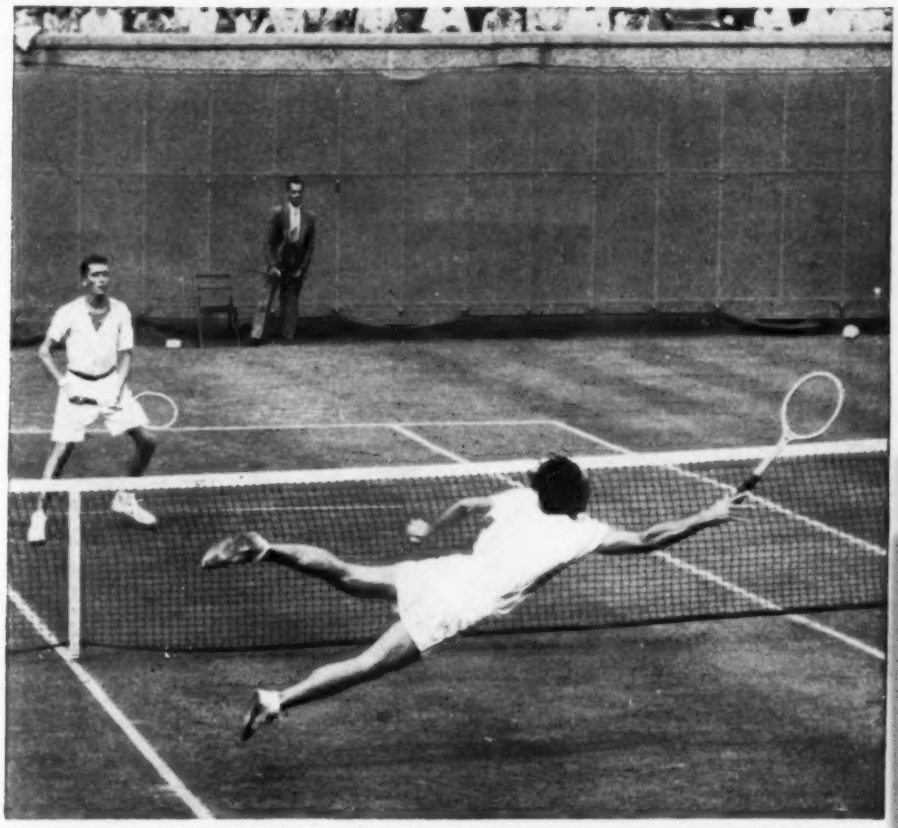
When shooting from the side lines, remember the cash customers. If you jump up at critical moments, they won't like it. Squat down, out of the way. Besides keeping you from becoming unpopular, the low angle probably will give a more dramatic picture.

At almost all fight arenas, the normal ring lights make it possible to take pictures, without flash, at 1/150 and 1/200 sec. at f/4.5 if fast film is used and development is correct. With that speed, one can catch all the good action without a blurry result. In fight pictures, you develop a second sense. You actually outguess the fighters. You learn to feel the punch coming and shoot the instant it lands.

With synchronized flash available for most cameras, I believe an amateur also might well try basketball. Some excellent shots have been taken from a front-row seat. From a distance of 30' from the basket you could get a well exposed negative with one peanut bulb. I have seen good results made with roll-film reflex-type cameras.

In photographing the finish of a horse race, you may find it difficult to concentrate on getting the picture while the horse you are betting on is coming up from behind. But it can be done. Keep your right eye glued on the camera finder while watching (if you must!) your own horse with the left. Never keep the camera rigid and wait for the horses to appear in the finder. Pan with the horses, keeping the leader always in view and shooting just ahead of the finish pole. In this manner, you never will lose the winner.

On the occasions when the leader is so far out in front that a one-horse finish is certain, a quick change of focus will permit shooting back down the track to show the winner lengths in front, with the place and show horses also in the picture. A one-horse finish never tells the story **END**



First prize winner in the sports division of the New York Press Photographers Show in 1946, this tennis shot was made by Photographer John Lindsay of the AP with a Speed Graphic. He shot at 1/500 sec. at f/8.

Panning makes the background fuzzy, but at the races it will enable you to use a slower shutter speed. Keep the lead horse in the finder while you pan, or you may shoot the finish—and not get the winner.

Hi-Fi Amplifier Gets ALL the Music

It has power and quality, and will faithfully reproduce the output of pickup, mike, or radio tuner.

By Harry R. Hyder

MANY amplifiers claim the flattering title of high fidelity, but relatively few satisfy the major requirements of accurate record reproduction. It is true, of course, that there is a good deal of argument as to just what is meant by the term, but all definitions agree on at least two things.

Minimum Distortion

The first requirement is low distortion. This means that each stage must have a reserve of gain so that it is worked well within its maximum ratings at all volume levels. Tubes and other components tend to distort a signal when driven at or near their theoretical limits. While the reserve is important for all parts of an amplifier, it is particularly needed in the power-output stage. For good volume in an average room, only one watt of power is required, but occasional sound peaks may call for several times as much, and the amplifier should be able to deliver these peaks faithfully and without overloading. A high-fidelity amplifier, then, needs at least five watts of undistorted output power.

Frequency Coverage

Wide frequency range is the second important requirement. Practically all fundamental musical notes are below 5,000 cycles per second, but the overtones—the harmonics or multiples of the fundamental—that give musical instruments their characteristic sounds extend beyond the range of the human ear to about 15,000 cycles. At the present state of the recording art, the highest audio frequencies cannot be put on commercial disks, but the best new records exceed 10,000 cycles, and your amplifier should be capable of reaching this level without any falling off in output. At the lower end, the limit is set at about 50 cycles. Good bass reproduction, however, is easier to achieve than good treble.

Test Results

How does this amplifier meet high-fidelity requirements? Actual tests were made on several units built from the same plans with similar but not identical parts. In each case the output was measured at 9 watts or more before distortion became audible; at 5 watts distortion read less than 2 percent. Frequency response proved virtually flat from 50 to 10,000 cycles—that is, all notes between these limits were amplified about equally.

Because the amplifier has power as well as quality, it can be used not only with a radio tuner and record player as a complete radio-phonograph combination, but also with a microphone to make a public-address system.

Construction Notes

The first, or phono-input terminal, I1, is followed by an equalizing network, R1 and C1, and then by a 6SJ7 input amplifier. When this tube is wired as a pentode, the gain of the stage is more than 100. Since this is much greater than will normally be needed, an alternative circuit is given in the drawing. Tying screen and suppressor grids to the plate changes the tube to triode operation, and makes it possible to omit several components. As a rule, triodes give lower output than pentodes, but also have less tendency to produce distortion. Unless you intend to use the amplifier for public address, you will find the triode circuit completely satisfactory. To find where the wires go, simply lay the shaded portion of the diagram over that part of the original which is drawn inside the broken-line box, so that the connections V, Y, and Z coincide.

For the second stage a 6N7 is used as a phase inverter in a self-balancing degenerative circuit. Part of the output of the first triode inside the tube envelope is fed back to the grid of the second triode in opposite phase to the original signal. This produces the out-of-phase signals that are fed to the

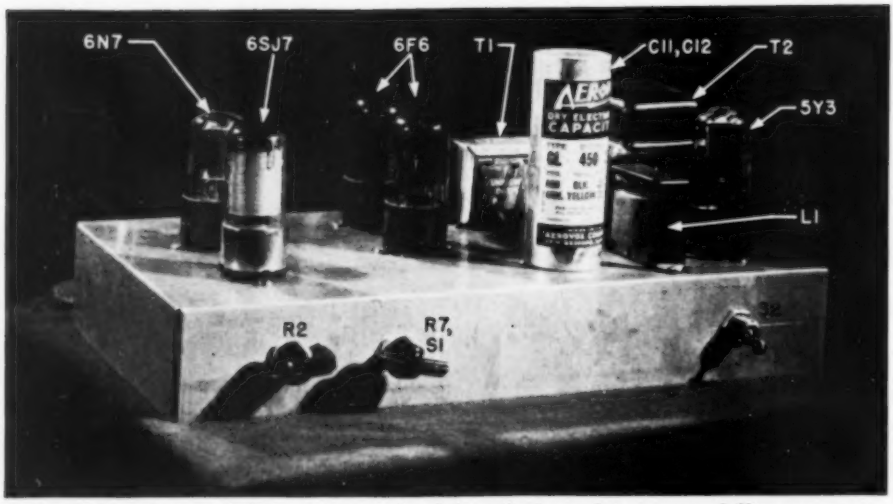
These three units and a carrying case in which the speaker is baffled make a complete portable PA system.

push-pull grids of the 6F6s. Strong signals from a microphone or tuner may be fed directly to the 6N7 through input terminal I2, thus by-passing the equalizing network and first amplifier as well as the volume (R2) and tone (R7) controls. Since microphones and tuners vary, try both inputs and use the one that gives best results.

Tone control, in itself, is usually a compromise with high fidelity. A condenser and variable resistor silence upper-frequency noise merely by shunting these frequencies to ground. But while this gets rid of the noise, it also loses the notes with which it is mingled. Many high-fidelity enthusiasts feel that a small amount of noise is preferable to tone-controlled music. To satisfy both sides of the argument, R7 has been connected directly to switch S1, making it possible to cut it out of the circuit entirely.

Two 6F6s in push-pull form the heart of the power-output stage. They are connected as triodes in the interest of low distortion and high speaker damping. A 5Y3-GT is used as the full-wave rectifier in the power-supply circuit.

The entire amplifier is mounted on a standard 2″ by 7″ by 13″ metal chassis. As can be seen in the photographs, the space is not used tightly and a smaller chassis may be substituted if cabinet dimensions demand it. Power-supply components are placed at one end and the input stage at the other, while the phase inverter, output tubes, and output transformer occupy the center of the chassis. The principal precaution to be observed in wiring is to keep the AC filament leads spaced as far as possible from the grid leads, especially in the sensitive input stage. It is also suggested that the 6SJ7 socket be



The input stage at one end of the chassis is isolated from the heavy-duty power and filter components.

mounted on live-rubber grommets to reduce any tendency toward microphonics.

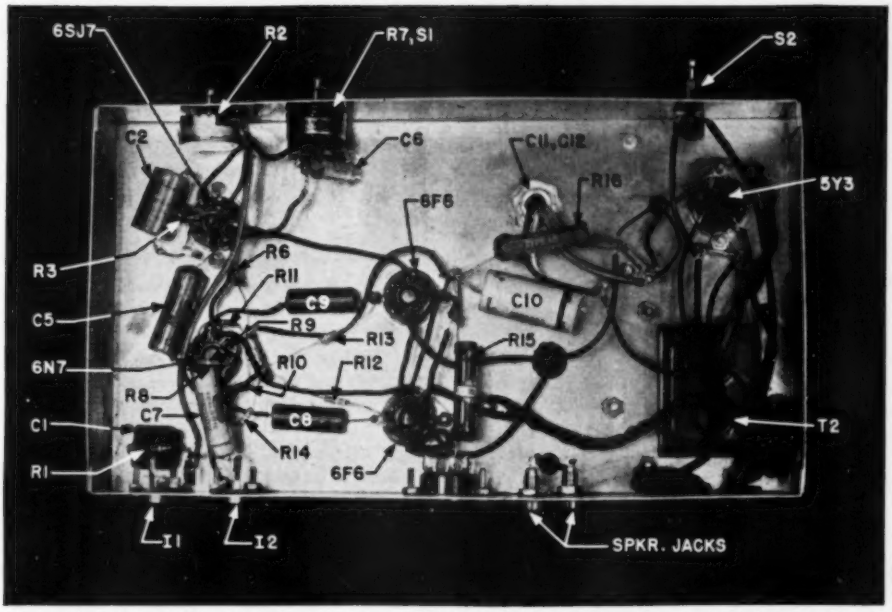
Pickup and Speaker

So far as actual sound quality is concerned, a high-fidelity phonograph amplifier is no better than its pickup and speaker, so a few words on these may be in order. Crystal pickups are used almost universally today because of their low cost, high output, and generally good performance. As a rule, pickups of low output voltage have slightly better quality than the high-output types. Since this amplifier has such an abundance of power, the choice of a pickup should be made for quality rather than output. Better pickups are also noted for light weight; many different ones are now available with a needle pressure of about 1 oz. With most records, crystal pickups have higher output at low frequencies than at high. Therefore some form of equalization is needed to boost the treble. In this amplifier it is accomplished by R1 and C1. Note that these are in the circuit only if the pickup is connected at I1.

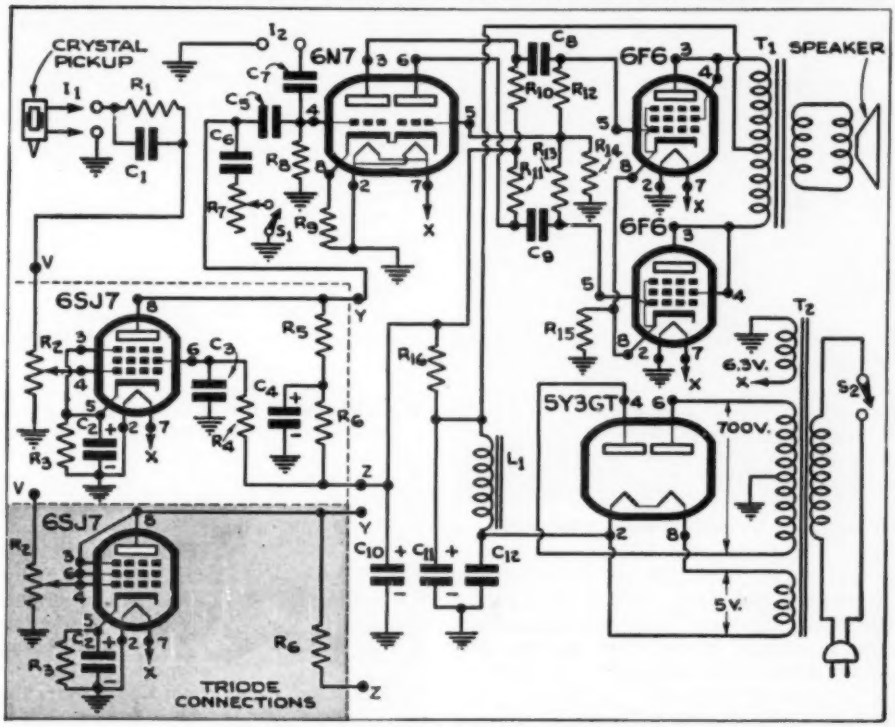
The speaker selected should be capable of handling the full power of the amplifier without overloading and distorting. Mount it in a solid baffle of adequate size. For best bass reproduction, a speaker of at least 12" diameter is recommended. Speakers of the coaxial type, consisting of a small high-frequency cone, a large low-frequency unit, and a dividing network, give maximum coverage but are quite costly. The better permanent-magnet speakers now on the market give very satisfactory response and are priced much lower. For public-address work, two or even three speakers may be used. If they are identical, connect similar terminals together; if they are not, experiment with the connections until you get the speakers in proper phase. See that the units are at least five feet from the mike, pickup, and amplifier. When they are grouped too closely, acoustic feedback or "howls" may occur at high volume levels. END

LIST OF PARTS

R1: 2.2 meg., ½ watt.
R2: 1-meg. volume control.
R3: 1,500 ohms, ½ watt.
R4: 1 meg., ½ watt.
R5, R14: 270,000 ohms, ½ watt.
R6: 47,000 ohms, ½ watt.
R7: 100,000-ohm potentiometer.
R8, R12, R13: 470,000 ohms, ½ watt.
R9: 3,300 ohms, ½ watt.
R10, R11: 100,000 ohms, ½ watt.
R15: 800 ohms, 5 watts.
R16: 2,000 ohms, 5 watts.
C1: 750 mmf., mica.
C2: 25 mfd., 25 volts, dry electrolytic.
C3: .05 mfd., 400 volts, paper.
C4, C10: 8 mfd., 450 volts, dry electrolytic.
C5, C8, C9: .1 mfd., 400 volts, paper.
C6: .005 mfd., 400 volts, paper (if 6SJ7 is pentode), or .01 mfd. (if used as triode).
C7: .02 mfd., 400 volts, paper.
C11, C12: 20-20 mfd., 450 volts, can type, dual electrolytic.
T1: 10-watt universal output transformer.
T2: Power transformer, 350-0-350 volts, 100 ma.; 6.3 volts, 3 amp.; 5 volts, 2 amp.
L1: 10-hy. 100-ma. filter choke.
S1: SPST on R7.
S2: SPST toggle.
Speaker, chassis, tubes, sockets, misc. hardware.



Above, the 6SJ7 amplifier is wired as a triode, and C3, C4, R4, and R5 have been omitted from the circuit.

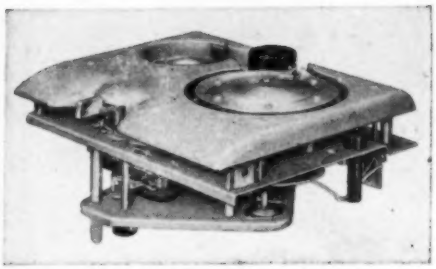


Two input circuits make it possible to leave both pickup and tuner permanently connected to the amplifier.

NEWS IN ELECTRONICS

Shaft Can Be Clipped. Aluminum shafts are now used on Clarostat controls in place of the usual steel rod. Instead of sawing it to length, the serviceman can simply clip off the excess with a pair of heavy-duty wire cutters.

Control Tunes Four Circuits. A new ham transmitter, first to be manufactured by the Hammarlund Manufacturing Company, features a device that tunes an oscillator and three multiplier stages with one control. It is said to be the first time this has been done without loss of efficiency. The 20-watt transmitter is shown above (right) with a companion modulator; the two units make a complete phone rig.



Wire-Recorder Foundation. Experimenters who have put off building their own wire recorders because of the difficulty of making the magnetic head and wire-transporting mechanism will now be able to buy a foundation unit including these essentials. It is made by the Webster-Chicago Corporation, and has a constant-speed motor geared to record at 2′ per second and rewind at seven times that speed.

Germanium Varistor. For telephone or telegraph modulation, full-wave meter rectification, or other applications where four matched and balanced diodes are needed, Sylvania offers the plug-in unit shown at the right. It contains four germanium crystals similar to the 1N34. Forward resistance of the diodes is matched to within 2.5 percent. Point contact reduces capacitance and extends the useful frequency range.

Resistors Are Ribbon-Wound. A new type of noncarbon resistor with the accuracy of wire-wound ones is being manufactured by Continental Carbon Inc. of Cleveland. It is made by winding metal resistance film around a low-loss ceramic base, and is said to remain accurate within 2 to 5 percent despite overload and temperature or humidity changes. Ratings are from ½ to 5 watts and values from 1 ohm to 100 megohms.

Contact Mike Boosts Music

PRACTICALLY any radio can be used as an electronic booster for your violin, guitar, piano, or similar instrument. A contact microphone feeds the music into the amplifier section of the radio. If the set has a high-gain audio system, the electrical connections may be made directly; a typical installation is shown in the drawing at the lower right.

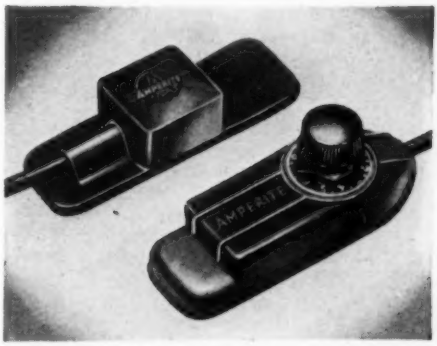
Radios that don't give all the amplification you want can be pepped up with another audio stage as shown in the diagram below. Tube V1 is the detector-amplifier already in the receiver—probably a 6SQ7, 12SQ7, 6SR7, or the like. Break the grid circuit at the point marked X, and wire in a switching jack as shown. For AC-DC sets using 150 ma. tubes such as 12SA7, 12SK7, 50L6, or 35Z5, the extra tube and associated parts values are given in column A below. Other AC-DC sets with 300 ma. tubes (6SA7, etc.) take the values in column B. Column C applies to straight AC sets with such tubes as the 6SJ7, 6SA7, and 6SK7.

For sets of the last type, connect the heater of V2 in parallel with those already in the circuit; in the case of all AC-DC sets, wire it in series with the other tubes at the ground side of the line.—WILLARD MOODY.

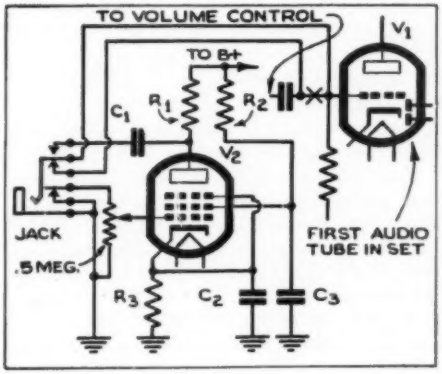
TABLE OF VALUES

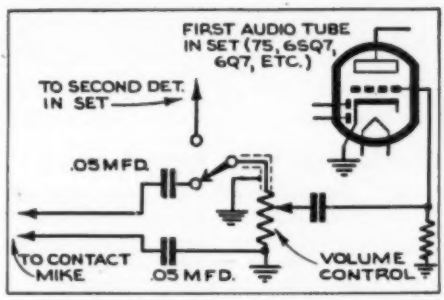
	A	B	C
R1:	.5 meg.	.5 meg.	.5 meg.
R2:	2.4 meg.	2.4 meg.	2.5 meg.
R3:	2,400 ohms.	2,400 ohms.	1,500 ohms.
C1:	.0015 mfd.	.0015 mfd.	.0015 mfd.
C2:	5 mfd., 25 v.	5 mfd., 25 v.	10 mfd., 25 v.
C3:	.05 mfd.	.05 mfd.	.05 mfd.
V2:	12SJ7	6SJ7	6SJ7

A little rubber cement was used to attach the contact microphone to this flat-top guitar. You can find the best place for the mike by actual trial.



Contact microphones come in a variety of styles, with hand and foot controls. The two models shown above are made by Amperite Company, of New York.



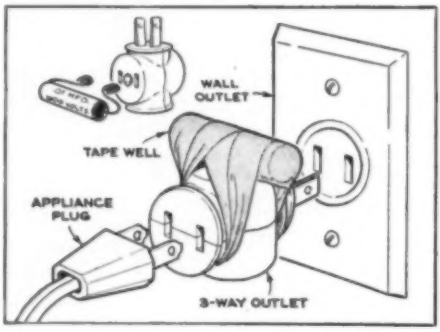


The diagram above shows a simple installation between the detector-audio stages; at left, a more elaborate method, using an extra amplifier tube.

A compact air-gap motor, right, is shown with a conventional unit of equal power. The new motors are being produced in sizes from ½ to 10 hp.

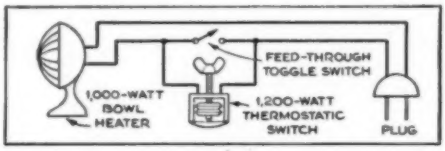
Pancake Motor Saves Space

RECENT developments in manufacturing technique have made it possible for Fairbanks, Morse & Co. to put into commercial production a line of axial air-gap motors that are both smaller and lighter than conventional motors of the same power. Stator and rotor cores are constructed as relatively flat disks, and the rotor turns in a plane parallel to the field faces. The new motors are especially suited for flange mounting on power tools. They may be used in direct-drive or belt application; for the latter, a special base is provided in which the entire motor can be quickly pivoted in order to obtain proper belt tension.



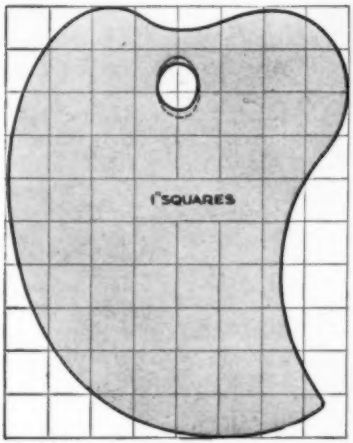
Condenser Cuts Interference

AT LEAST part of the radio interference caused by electric shavers, vibrating tools, and similar appliances can be eliminated by placing a condenser across the line at the noise source. Tape a .01-mfd. 600-volt capacitor into one side of a three-way outlet and plug the appliance into another side of the same outlet.—RALPH S. WILKES.



Thermostat Warms Nursery

BECAUSE of uneven heat distribution in my home, bringing the second-floor nursery to a comfortable temperature resulted in overheating the living quarters on the lower floor. To obtain proper regulation, I rigged up a nursery-heating system that is both independent and inexpensive. It consists of a 1,000-watt bowl heater and a bellows-type, screw-adjusted thermostat such as is used for poultry incubators. Trial and error determined the screw setting that kept the room at the desired temperature. An extra feed-through switch across the thermostat allows the current to be kept on when extra heat is needed, as at bath time or when dressing the children.—JOHN S. PARSONS.



Buffet Sandwich Board Is Shaped Like Palette

For making and serving sandwiches at informal parties, or preparing vegetables in the kitchen, a cutting board of 3/16″ or ¼″ hard composition board adds a decorative touch if sawed out in the shape of an artist's palette. The material is waterproof, needs only a coat of linseed oil for a finish, and will stand repeated washing.

A set of different sizes may be made and will take no more space than one wood board when hung on a wall peg. Merely vary the size of the squares.—W. A. Conway.

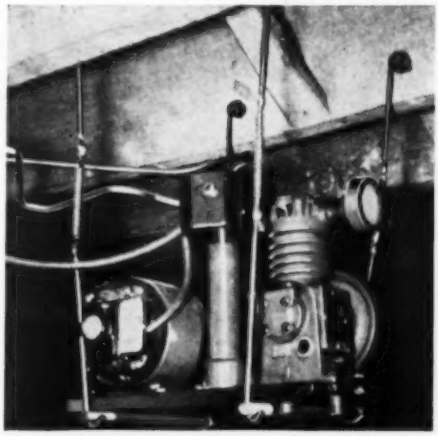
Marking Your Garden Rows

Small glass jars with screw tops make good waterproof and windproof markers for the rows in a vegetable garden. Nail the lid to a stake and insert the empty seed package before putting the lid back on. The date of the planting may be written on the package also, if desired, to provide a record of growth.—W. H. Fulker.

Lacquer Polished by Buffing

High glosses like that on plastic can be obtained by buffing many hard lacquers on a muslin wheel. Use a soft wheel with one to three cardboard disks between the cloths.

Fine finishes are possible on metal and close-grained hardwoods. Round sharp edges and apply three coats of lacquer, letting the last dry overnight. Run the wheel at 3,500 r.p.m. Use a cake lacquer-buffing compound, and polish finally with lime composition. Sponge off any film with benzine.



Mounting Quiets Compressor

Noise and vibration of an air compressor hung from the joists to save space proved excessive in the house above. To quiet it, I made hooks of ¼″ welding rod and brazed them to both ends of lengths of 7/16″ door spring. Hanging the upper hooks on lag screws inserted through rubber bushings, I hooked the lower on ⅜″ by 10″ bolts on which the unit is set. No other platform was found necessary.—John G. Lownsbery.

Servicing the Gas Range

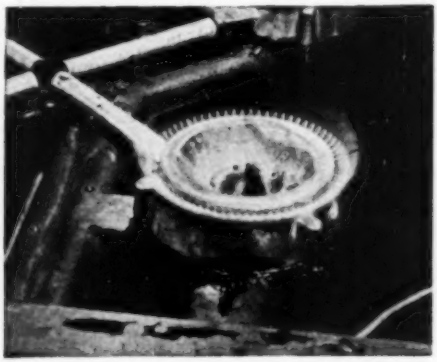
By Frank McCarty

IF THEY are to do efficient heating, the burners of a kitchen gas range must be kept clean and regulated. Degreasing compounds are available for cleansing both removable parts and the oven to eliminate one cause of kitchen odors. In stubborn cases, use a solution of 1 cup ammonia in 2 qt. hot water, or treat the oven with ammonia fumes. Rinse degreasing solution from burners with hot water and dry them thoroughly —a few minutes in the heated oven will do— before putting them back in place.

Repairs such as those required by broken door springs and loose handles can be made easily by the average handy man. He should also be able to patch or replace a burned-out oven lining and install new insulation if necessary. Both soft and hard asbestos are suitable insulating materials, but fireproof rock-wool blankets like the original ones are available cheaply at most building-supply houses and lumberyards.

Steps in cleaning, adjusting, and repairing typical gas ranges are illustrated on this and the following two pages.

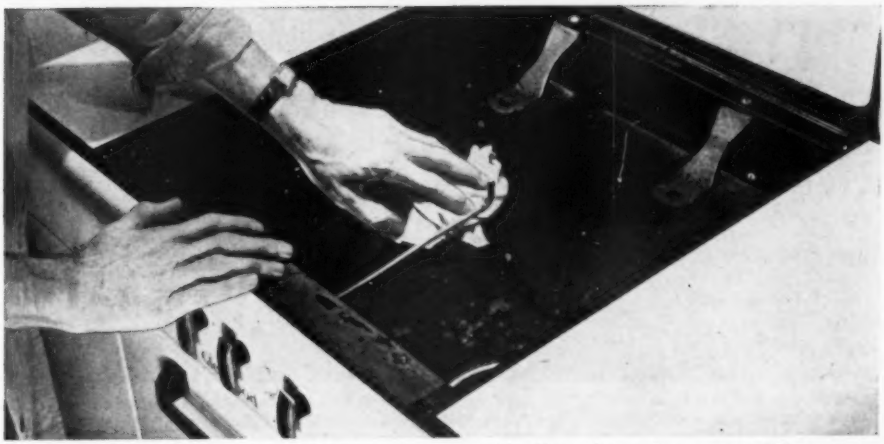
Burners are easily lifted out of the top of the range for cleaning. A commercial degreaser or a hot solution of household ammonia followed with rinsing in hot water clears the orifices.



When the burners are put back in place, the air and gas should be adjusted. The most efficient flame is pale blue and noiseless and ⅜" to ½" high. Too much air causes hissing.

Gas admission on the double-duty type of burners is also controlled by two valves. Unscrewing admits more gas. With the handle half on, the low flame burns; full on puts both in use.

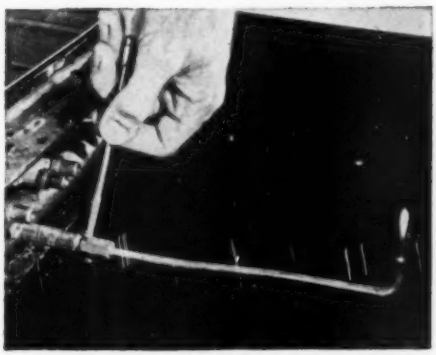
With an automatic pilot, a little gas escapes from a slit or holes in the burner, flows up a tube, and is lit by the pilot flame; flashing back, it lights the burner. A razor blade cleans the burner slit.



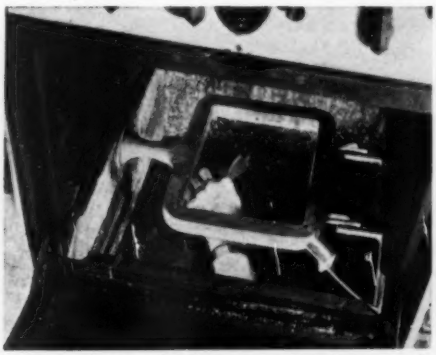
Frequent wiping of the drip pan under the burners saves trouble. Use a degreasing compound if necessary.

One simple, common type of burner has a rotating shutter to admit air. It can be adjusted when a screw is loosened. After the correct setting has been made, retighten the screw carefully.

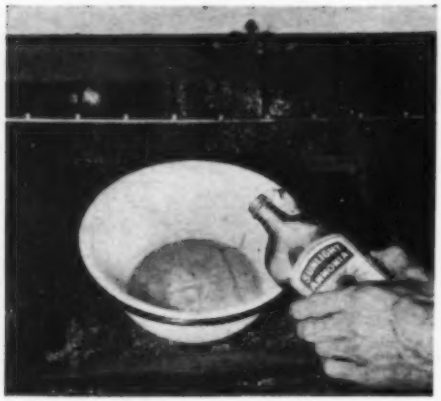
Another type of burner has an air adjustment in the form of a shutter on the end of the base and also requires loosening a screw. The one shown has a high- and low-flame valve for each burner.



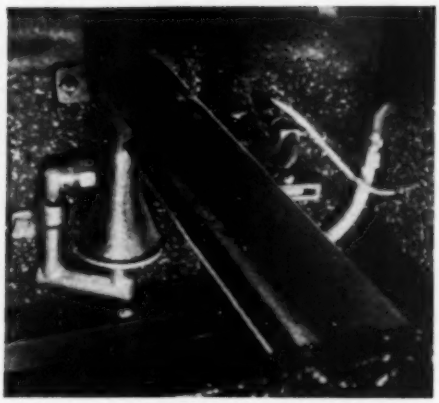
Most pilots have a yellow flame and no adjustment for air. Turn a valve or screw as shown or under the jet end for a small, steady flame. A clogged opening can be cleaned with a wire or needle.



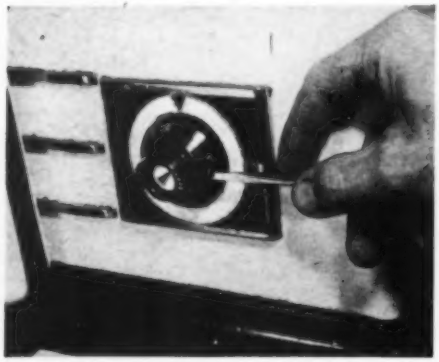
With the bottom, broiler pan, and racks removed, an oven can be scraped of batter and grease. The burner, being inverted, rarely requires cleaning. Adjust it like the top burners. [*Turn the page.*]



To soften baked-on grease, pour ½" of ammonia in a pan and lay in a cloth pad to act as a vaporizer. Plug the back flue and close the door; then after 12 hours wash thoroughly with soap and water.

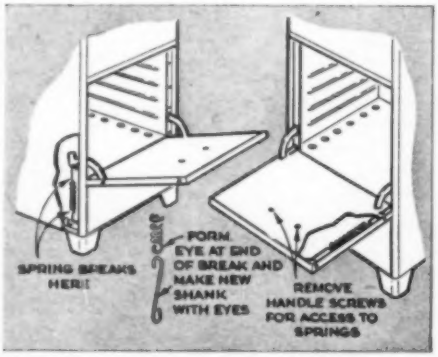


This type of oven burner has all the adjustments exposed and is handled as any other. At right is an automatic oven pilot similar to the pilot for the burners on the top of the range.



Actual oven temperatures can be checked against those indicated on the control dial by comparison with an oven thermometer. Correct any difference by loosening a setscrew and resetting the dial.

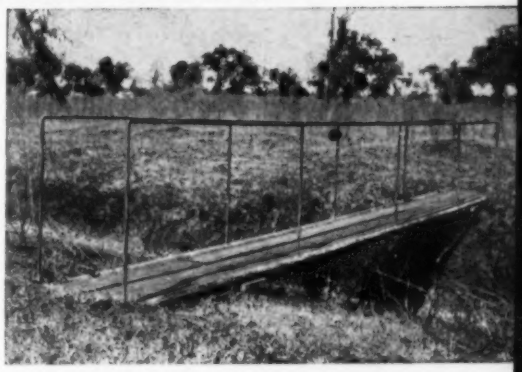
Plastic burner handles loosen when the spring in them breaks or wears. They can be held tight by a socket-type setscrew put flush in a drilled and tapped hole. It will be practically invisible.



Oven-door springs are either in the body of the stove or behind the lining of the door. Breaks are usually at either end of the shank. The old spring can be salvaged by adding a new shank.

A burned-out oven lining can be repaired with a sheet-iron patch held by self-tapping screws if the hole is small. An entire new lining can be bent from black sheet iron and bolted in place.

Welded Pipe Forms Removable Footbridge



WHERE it is occasionally necessary to reopen a drainage ditch or burn off weeds, a footbridge like this may be swung aside as a unit simply by hooking the line of a winch truck around it.

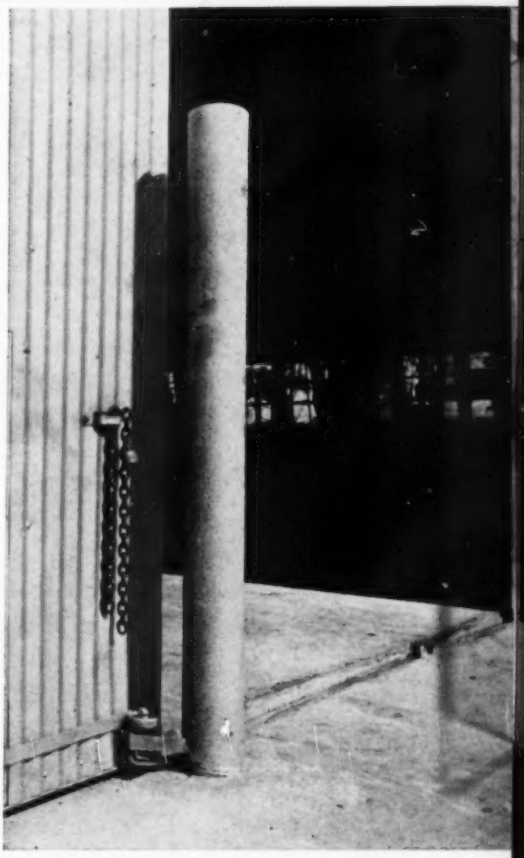
The base consists of two lengths of 2½" pipe welded 26" apart on centers by means of transverse ties of ¾" rod at 36" intervals. Endpieces of 2½" pipe have two 6"-long nipples of 2" pipe welded on at right angles to enter the open ends of the long pipes. Handrails of ¾" rod are welded to the long pipes. Flooring is made from two 2" by 12" planks held in position by cleats nailed below the supporting pipes.—ELTON STERRETT.

Buffer Posts Guard Sliding Shop Doors

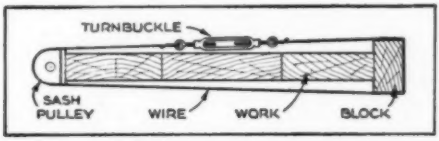
IF THE sliding doors of a shop are apt to be damaged by vehicles driving in or out, two posts of 6" pipe set into the concrete at either side of the driveway will give them protection. The photo at the right shows how it was done at one plant.

After the pipe had been installed in the driveway, four ¾" reinforcing rods were placed inside and the pipe poured full of grout. When this had set, the pipe therefore had several times the rigidity of a simple pipe post and also was protected against internal rust. The outside was coated with aluminum paint to correspond to the building.

Located at the extreme end of door travel, the posts also serve as a mounting base for the guide rollers that keep the doors in their track at floor level. This prevents banging of the doors by the wind and reduces wear on the overhead track.



If a driver should turn too short, a post set in the concrete on either side of the driveway like this will prevent shop doors from being damaged.

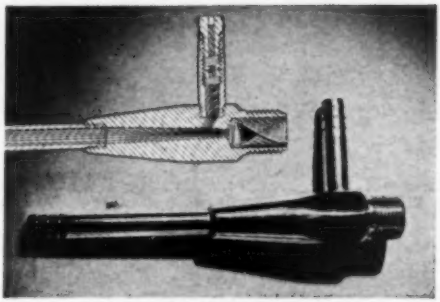


Turnbuckle Adapted as Clamp

WHEN wide boards are to be edge glued, clamps can be improvised from turnbuckles, sash pulleys, and picture-frame wire. Mounted on one edge of the boards, the sash pulley assures uniform tension of the wire on each side of the work. A block of wood on the opposite edge prevents the wire from cutting.—F. E. AVERILL.

Vacuum Pump Does

WITH a simple aspirator-type vacuum pump, it is possible to perform many interesting experiments with air at reduced pressures. Available at low cost from scientific supply houses, such pumps produce suction when used on a water faucet. They work on the principle that water rushing through a long tube drags in air through a shorter side tube, or to put it more scientifically, water passing through a venturi tube reduces atmospheric pressure in a tube entering the venturi. For use in the lab, this suction may be harnessed by attaching a length of rubber tubing to the side tube.



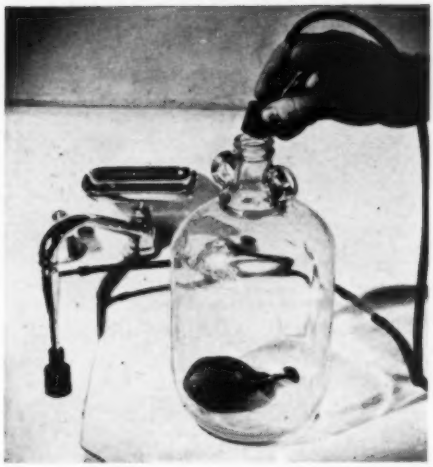
Screw the threaded end of the pump, right, into a faucet, and press rubber tubing on the short tube.

Feather Falls Like Coin. With a vacuum pump, you can duplicate a classical experiment that proves a feather and coin fall at the same rate in a vacuum. Place a tight stopper in one end of a glass tube that is at least 24" long and an inch or two in diameter. In the other, place a one-hole stopper with a glass tube connected to the pump tubing. Using a scrap of paper and a nail, try the experiment first with normal air pressure, inverting the tube quickly to start both objects falling together. Then evacuate the tube and see the difference.

Fountain Flows Inside Jug. A novel fountain may be produced with the setup illustrated here. Get a large glass jug and a bottle that is small enough to go through its neck, and one-hole stoppers to fit both. After filling the bottle half full of colored water, thrust to the bottom a glass tube that has been drawn to a fine jet at the upper end. Lower the bottle to the bottom of the jug, attach the vacuum pump, and apply suction. As the air pressure in the jug is lowered, the greater pressure in the bottle forces water out the jet.

Strange Stunts

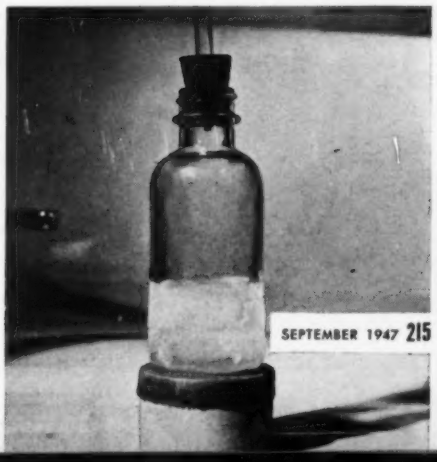
HOME EXPERIMENTS

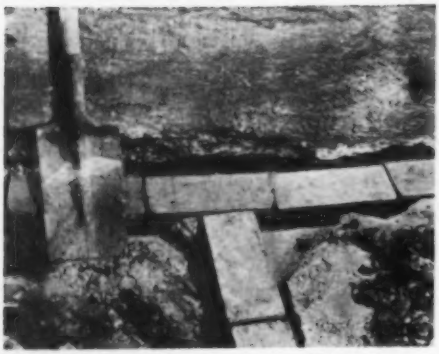


Balloon Blows Itself Up. Ordinarily, you expand a toy balloon by increasing the pressure inside, but here is a method that accomplishes the same result by reducing the pressure—outside. Inflate a balloon with just a little air, squeeze it into a gallon jug, connect the jug to the vacuum pump, and start the pump. As air is drawn from the jug, the greater pressure inside the balloon will cause it to expand. This illustrates why man-carrying balloons have safety valves to relieve excess pressure at high altitudes and why they are not completely filled on leaving the ground.

Boiling Point Reduced. A liquid boils at the point where its own vapor pressure equals the pressure of the atmosphere pressing down on it. Hence, if the atmospheric pressure is reduced, the boiling point is likewise reduced. You can demonstrate this by placing some lukewarm water in a 2-oz. bottle and reducing the pressure in the bottle with your vacuum pump. The water inside will boil violently until it cools to a temperature just slightly above that of the water flowing through the pump.

Boiling Produces Ice. While boiling, any liquid extracts heat from its surroundings. In the experiment at the left, the boiling water gets heat from the bottle and surrounding air. Consequently, these are cooled. This cooling effect may be carried to an ice-producing stage by substituting for the water a low-boiling-point liquid such as acetone. Moisten the outside of the bottle with water and stand it on a cardboard box or other insulation. As pressure is reduced, the moisture on the bottle will freeze.

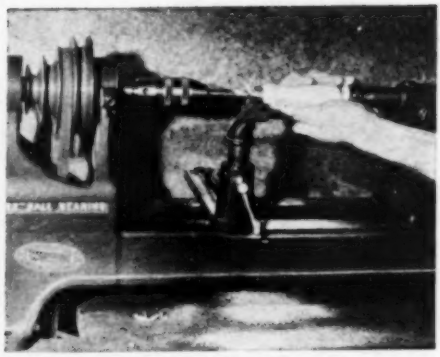




Building Tile Used as Drain

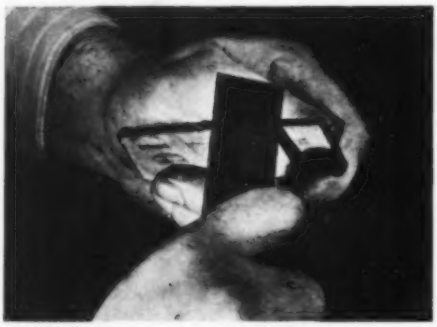
When regular drain tile is unavailable, square or rectangular building tile will make a good substitute. It is sometimes even superior because of its shape.

Used, as in the photo, for draining a basement into which water was seeping, rectangular tile fitted easily into a ditch cut in the floor near the leaking wall. The cost was the same as that of drainage tile.



Tool Rest Gauges Depth

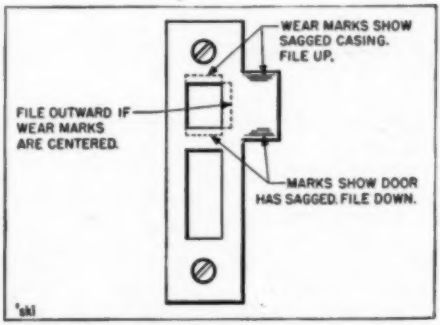
Swung across the bed of a woodworking lathe, the tool rest serves as an excellent stop when holes of the same depth must be bored in pieces of different length. The sharp edge of the tool rest is turned toward the tailstock. It will then stop the work at the same spot each time, the pieces to be drilled being fed against a bit chucked in the headstock.—Glenn A. Wagner.



Polishing Plastic Edges

Scraping the edge of clear plastic to a dull finish before final polishing will save much time. A scraper for the work can be made from a length of steel such as an old power-hacksaw blade or a good wood scraper. Grind the cutting edge square, and then sharpen with the square edge flat on a carborundum stone. Touch up with an India stone or other fine-grit stone, and hone to a mirrorlike finish on a leather strop.

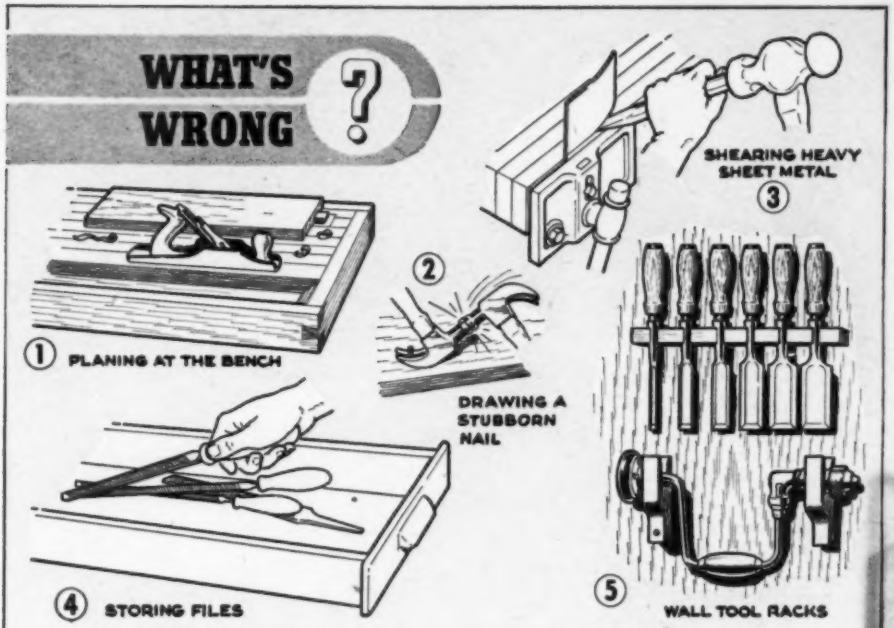
To use, hold the scraper at a slight angle and draw its edge along the edge of the plastic. When a smooth, dull finish is obtained, polish with compound. If the plastic is very rough, sand with 3/0 sandpaper before scraping.—Eli S. Eisenhard.



Making a Door Stay Shut

Much easier than resetting an offending strike, when the latch of a door lock will not catch properly, is the alternative of filing the slot a little larger. Don't try to do this on the jamb, but remove the strike and clamp it in a vise for the job. It can then be replaced and the screws put in the same holes without plugging and respotting them, or enlarging the mortise.

Wear marks on the strike usually show whether it was too high or too low for the latch. If these are lacking, the latch has not been passing far enough inward, in which case the outer edge of the slot needs to be enlarged. Frequently no more than 1/16" of metal need be filed off.



HERE are five errors in handling woodworking tools, some of them common. How many can you spot? Compare your answers with those printed upside down.

ANSWERS: 1. After using a plane, lay it on its side or set it in the tray with the toe resting on the frame end of the bench. This prevents dulling of the plane iron by gritty dirt.

2. Driving the hammer claws against a headless nail is often an effective means of getting a grip, but there is also risk of breaking a claw.

3. A woodworker's vise is not built strongly enough for heavy metal work.

4. Filing files together in a drawer dulls them. A separate groove or compartment is needed for each.

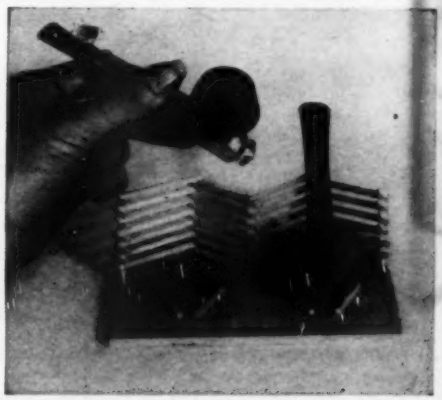
5. This arrangement invites cut fingers when you remove the brace, which is too near the chisel edges. A cleat is needed under them as a guard.

Kitchen-Match Rail Fence Is Unusual Pipe Rack

A FEW minutes with a handful of wooden matches, a razor blade, and some good glue will provide you with an interesting pipe rack. Two or more pipes can be supported simply by varying the length of the fence.

The base is ¾" plywood or other thin stock cut to required size. Cut the matches off just behind the heads, and cut also some short match lengths to separate the rails at the two outer ends. A drop of glue should be sufficient for each joint. The zigzag design gives considerable strength.

Finish with paint or varnish when the glue is dry. Use a camel's-hair brush for coating the rails.—CLIFTON MORRIS.



Two headless matches glued onto the base in front of each rail section are stops for the pipe bowls.

Count the drops of soap solution needed to produce stable suds on the surface of distilled water and on an equal amount of hard water. You then will have an indication of the relative hardness of the latter.

Until recent years, ordinary washing soda was the agent most frequently used for home softening of water. Soap added to water softened in this way produces suds about as freely as in soft water.

Now, however, you have a choice of such agents as these. Oakite precipitates the hardness, Calgon ties it up in complex compounds, while Dreft, one of the new synthetic detergents, just ignores it.

How Chemistry Softens Water

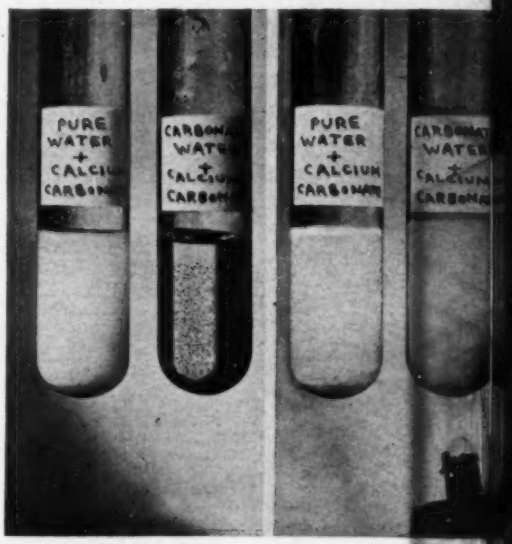
By Kenneth M. Swezey

BECAUSE water is such a good solvent, it is never found absolutely pure in nature. Even while falling as rain, it takes oxygen, nitrogen, and carbon dioxide from the air. As it runs over rocks and through soil, it dissolves salts of calcium, magnesium, and other elements. If it reaches you with less than 100 ppm (parts per million) of such mineral salts, it is said to be soft. If there are more, it is called hard.

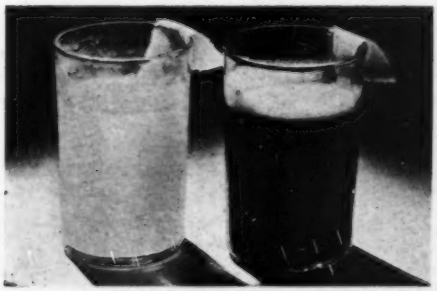
Since mineral salts form scum in wash water and crusts inside boilers and pipes, hard water has long caused a lot of inconvenience and costly damage. Thanks, however, to better methods of removing the offending chemicals, new compounds that render them inactive, and synthetic detergents that do not react with them, both inconvenience and cost are now less.

Hard water is a costly nuisance chiefly in the processes of cleaning and heating. Soap usually consists of a salt of sodium with some organic acid, such as stearic or oleic. Dissolved in water containing calcium or magnesium, soap reacts by a double decomposition process, forming insoluble, sticky, and curdy stearates or oleates of these metals. Until enough soap is added to react with all the hardness, the soap has no power to clean. Furthermore, when cleaning finally becomes possible, the sticky and insoluble salts make it more difficult.

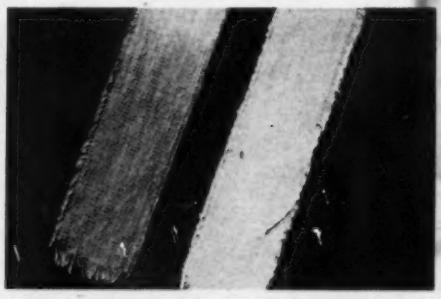
In heating systems, the effects of hard water may be still more serious. When water containing carbonate hardness is heated, an insoluble scale is deposited inside the pipes and boilers. Even in a thin layer, this scale reduces the transfer of heat to such an extent that the boiler metal may become overheated and corrode excessively or crack. Layers sometimes become so thick



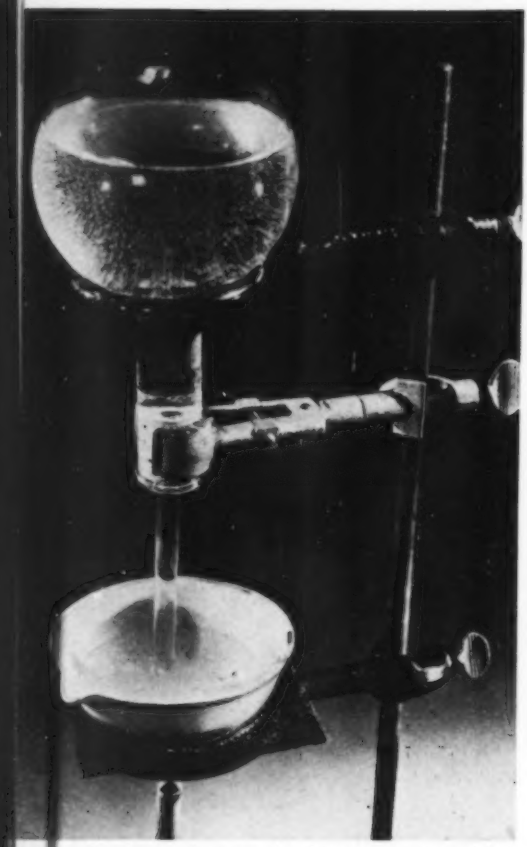
Various carbonates dissolve much more readily in water containing carbon dioxide, as at left. Such water is said to have temporary hardness because boiling, as at right, precipitates the carbonates.



In water containing a little iron, soap produces a pale precipitate. If washing soda is added, this looks even worse. That it actually is not may be shown by placing a strip of white cloth in each.



After the strips have been rinsed and dried, the one from the hard water turns a rusty brown. The second precipitate, however, rinses out easily and the strip of cloth will dry to a pure white.



By evaporating some hard water, you can solidify the salts that make it hard. Push tubing through a one-hole stopper in a 500-ml. flask, adjust so the tube is ½" above the dish bottom, and water will rise in the dish only to the end of the tube.

As the water boils away, more will descend, and finally only solids will remain. Magnesium and calcium salts are white, those of iron are brown.

in pipes that the water flow is seriously impeded—or even stopped. Noncarbonate hardness also forms scale in steam boilers as the water boils away.

To combat the effects of hard water, modern chemists have devised three methods: 1, precipitation of the hardness by boiling or chemical action; 2, treatment of the water with chemicals that prevent curd formation and boiler scale; 3, where cleaning only is important, the use of detergents (other than soap) that clean but do not react with hard water.

Water containing carbonate hardness is sometimes referred to as "temporary" hard water, because mere boiling is sufficient to soften it. Such water owes its hardness to dissolved calcium bicarbonate and occasionally smaller amounts of the bicarbonates of magnesium and iron. These are produced by the reaction of water containing carbon dioxide with the normal carbonates of these metals. When such hard water is boiled, the bicarbonates are decomposed, forming insoluble calcium carbonate, iron carbonate, and magnesium hydroxide. These settle out, leaving the water soft.

The reactions that cause the formation and destruction of carbonate hardness are easily demonstrated. Shake a few specks of precipitated chalk (calcium carbonate) in about 10 ml. of distilled water in a test tube. Like pure water flowing over limestone rock in nature, this water dissolves virtually none of the chalk, but forms with it a milky suspension that settles out.

In a second test tube, shake an equal amount of chalk in water that contains carbon dioxide—carbonated water, or distilled water through which carbon dioxide has been bubbled for several minutes. This time the chalk dissolves and a clear solution results, duplicating what happens in nature when rain water charged with carbon dioxide flows over limestone. The water in this tube now has carbonate hardness.

As a demonstration of how such hardness may be removed, heat the water in this tube to the boiling point. The excess carbon dioxide will be quickly driven off and the clear water will be whitened by a precipitate of the original normal calcium carbonate, which will settle to the bottom.

Although boiling offers an easy method of softening small quantities of such water for purposes of washing, water with carbonate hardness is softened on a large scale and for boiler use by treatment with lime and soda

ash (sodium carbonate). Unfortunately, the use of lime is not feasible for the average homeowner because it must be added in exact amounts that vary with changes in the carbonate content of the water. A slight excess would actually harden the water.

A second type of hardness produces what is known as "permanent" hard water. This hardness usually consists of the sulphates of calcium and magnesium, with sometimes smaller amounts of the chlorides of these metals. Boiling does not alter these salts. They must be removed chemically.

In the past, the chemical most frequently used for home softening of this type of hard water has been common washing soda (hydrated sodium carbonate). This reacts with the hardness and forms a precipitate of calcium, magnesium, or ferrous carbonates. It is far cheaper than the extra soap that otherwise would be needed.

Trisodium phosphate, abbreviated as TSP and the basis of several proprietary products (for instance, Oakite), is another household water softener that has become popular in recent years. It precipitates tricalcium phosphate, magnesium phosphate, and iron phosphate. Although TSP is more expensive than washing soda, the resulting precipitates are finer than those of the cheaper material and consequently easier to wash away.

Sodium hexametaphosphate, sold under the trade name of Calgon, is an excellent softening agent that works on a principle entirely different from the two first mentioned. It forms complex compounds with the hardening elements in the water, preventing them from reacting with soap or producing boiler scale. Since the compounds remain in solution and no precipitate is formed, the water stays as free from sludge as does soft water.

Comparative tests will show the differences between soft water, hard water, and hard water that has been softened by various methods. If you have no hard water for the experiment, some can be made by adding a few grains of calcium chloride, calcium sulphate (plaster of Paris), or magnesium sulphate (Epsom salts) to a glass of water.

For the experiment, set up a series of tumblers—one containing soft water, a second containing hard water, and others containing hard water softened with washing soda, TSP, and Calgon, if you have all of these. Add a small and equal amount of pure soap flakes or granules to each glass and shake it. You should be able to observe all the differences previously described.

To witness the newest method of conquering hard water without even bothering to soften it, add a little Dreft or Vel to another glass. These new synthetic detergents contain no soap at all, but they produce copious suds and clean well because they do not react with the hardness.

You may determine the amount of softening agent that must be added to any particular hard water by means of a simple suds test. Prepare a standard soap solution by dissolving 5 grams of castile soap in 100 ml. of warm 80-percent alcohol and then filtering. After placing a measured amount of distilled water in a clean bottle, add the soap solution drop by drop with shaking between each drop. Add soap until a foam covers the surface of the water and remains for half a minute.

Now replace the distilled water with an equal amount of hard water and add soap as before, noting the difference in the number of drops required to produce the same foamy condition. Keeping the amount of water constant, make a series of separate additional tests, adding different measured quantities of the softener to the water and emptying and refilling the bottle for each trial. Always add the softener before the soap or the latter will react with the hardness and spoil the result.

Your quest is ended when, on one trial, the amount of soap needed to form stable suds about equals that required for distilled water. The amount of softener used for this trial is the quantity needed for the particular hard water under test.

Even extremely small amounts of iron in hard water may discolor clothes and plumbing fixtures. When soap is added, a pale rust-colored precipitate is formed. This sticks to cloth and turns to iron rust when exposed to the air. If sodium carbonate is added to such water, the resulting green-brown precipitate looks much worse than the original brown. Actually, however, it is better—as you can show.

Stir a few grains of ferrous sulphate into each of two glasses of water. To one, add a pinch of washing soda. A dirty looking precipitate will form. Now add a little soap to each glass, wash a strip of white cloth in each, rinse in plain water, and allow to dry. You will find that the strip washed in the glass containing the precipitate will be white, the other stained with rust. END

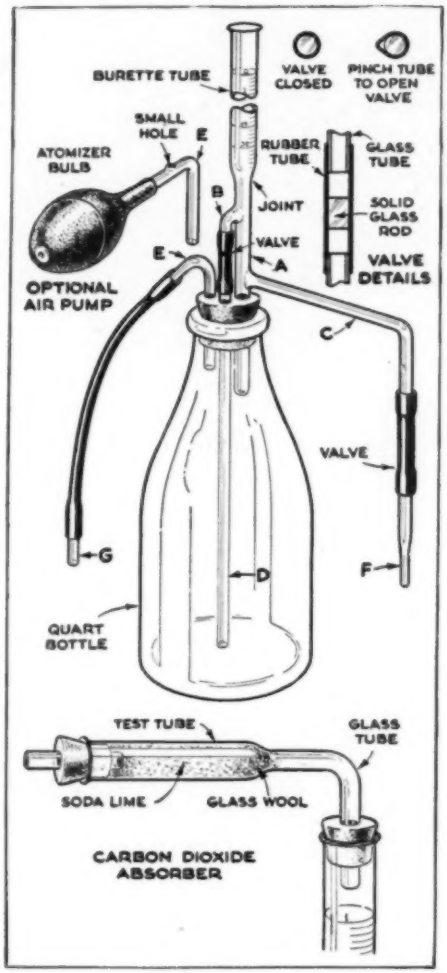
Laboratory Equipment You Can Make

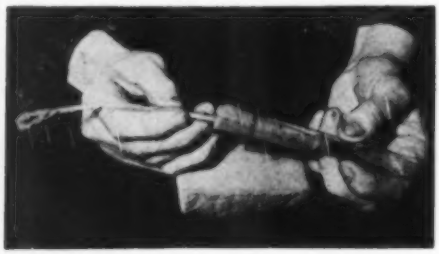
Burette Is Automatic. The home chemist who performs an occasional analysis can make this self-filling burette from a broken one provided at least 30 cc. of graduation remain. Heat the tube about 5 cc. above the lowest mark, rotating it in the Bunsen flame, and pull the ends to constrict the diameter to 10 mm. Scratch and break midway at the constriction. Cork the top.

Rotate and heat yellow one end of an 8″ length of 10-mm. soft-glass tube *(A)* and the cut end of the burette. Gently press together and then pull slightly apart to thin the joint. With a blowpipe and the yellow flame, reheat a little of the joint to shrink the glass. Remove from the flame and blow gently into the open end to round the area. Repeat all around to remove all lumps.

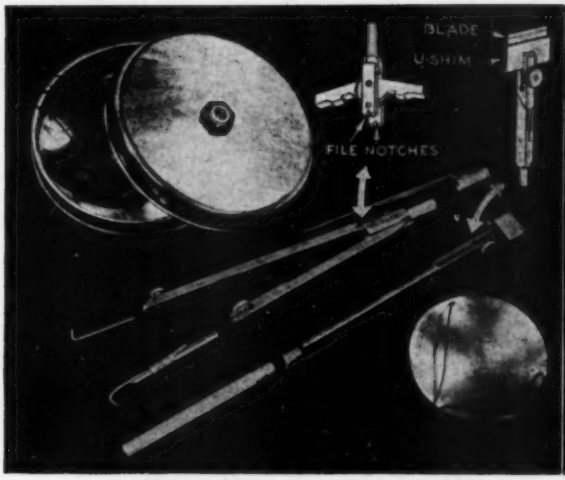
Side tubes *B* and *C*, each 7 mm. in diameter, are set into *A* at right angles to each other. *B* is 1″ below the joint, and *C* is 2″ below *B*. Holes to receive them are made by alternate heating and blowing into *A* until the bulging glass is so thin it can be filed off. Join the side tubes in the same way *A* was joined to the burette. Heat and bend *B* ½″ from *A*, and bend *C* at a distance equal to half the diameter of the bottle plus 2″. Finally, seal off *A* at a point 2″ below *C*. Rubber tubing connected to *D* and *F* form valves, either by use of ¼″ lengths of glass rod (as in the drawing) or of pinchcocks.

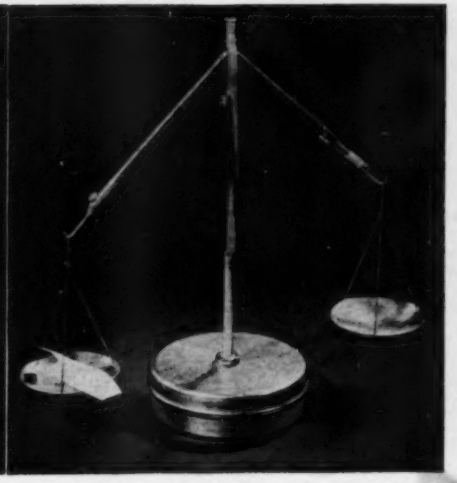
To fill the burette, blow into *G* and open valve *B*. When the level falls back to zero, close *B*. Titration may then be carried on through *F*. With alkaline solutions, an atomizer bulb used as an air pump will exclude carbon dioxide. A carbon dioxide absorber can also be inserted in the top of the burette.—Albert C. Nuessle.





Sponge Swabs Test Tube. One way to clean test tubes quickly and thoroughly is with a piece of cellulose or rubber sponge attached to a length of stiff wire. The sponge should fit snugly in the test tube when it has absorbed maximum water. With a sharp instrument work a hole lengthwise through the sponge, insert the wire, and bend back about ¼″ at the end so it won't pull through when the sponge is in the tube.—H. Klein.

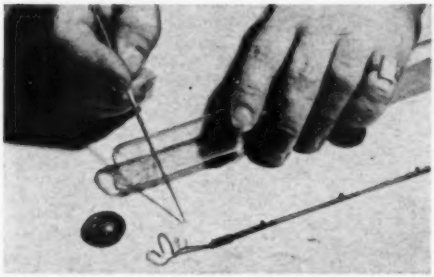




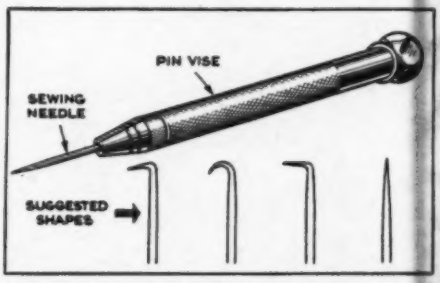
Drafting Tools Form Scales. An accurate balance for weighing chemicals and other small amounts up to several ounces can be assembled quickly from a drafting compass, pen handle, and extension bar. It is sensitive enough to weigh a cigarette paper. There is so little friction that, when set in motion without pans, the compass will oscillate 10 minutes.

The only alterations required are tiny, almost invisible notches at the bottom of the fork to which the compass legs are pivoted. These must be accurately centered and aligned. Make them shallow at first, and deepen if necessary. The knife-edge fulcrum is a piece of razor blade slightly dulled on a whetstone and clamped in a tin U-shim by the extension-bar setscrew. Bent-wire hooks replace the points in the compass legs to suspend pans made from the bottoms of small cans. Counterbalance the lighter leg with wrappings of foil, wire, or the like. Two pointers to show balance fit on the pen handle and the knurled compass grip.

Make a base by drilling a shoe-polish can and soldering on a nut. Slip the pen handle in the nut, assemble, and the scales are ready for use. For storage keep the accessories in the can and return the instruments to their case.—G. E. Harrington.



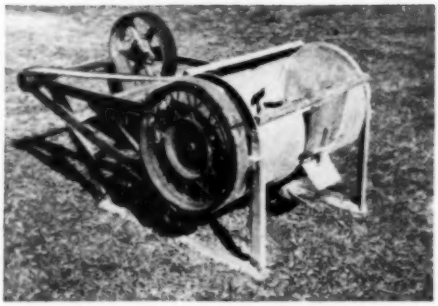
Tubing Cut from Lamps. Burned-out tubular incandescent bulbs make excellent large glass tubing. They can be worked with a Bunsen burner as readily as regular laboratory glass. Break the glass tip at one end to admit air; then file and break off cleanly and clear out the inside. After that the tubing can be broken accurately into desired lengths at file marks made to circumscribe it.—Kenneth Murray.



Pin Vise Holds "Scalpel." Dissecting and examining biological specimens can be facilitated with an ordinary sewing needle held in a pin vise, such as the small size selling for about 15 cents and sometimes listed as a scratch awl. Points of various shapes can be bent by heating the needle. Advantages are easy replacement of a corroded needle and the firm grip provided by the knurl.—Alfred Blaker.

Terracer Aids Contouring. A new weapon in the fight against soil erosion, this terracer corrects drainage outlets and conserves moisture. The combination plow and whirling screw conveyor is pulled by a tractor and can move 650 cubic yards of soil per mile. It throws it accurately to a distance of 20′, pulverizing it and eliminating the need for harrowing and disking. The terracer is marketed by the International Harvester Company.

Oiler Curries Cattle. For the greater comfort of cattle, the Farnam Company, of Omaha, produces the automatic currying and oiling equipment pictured above. A 5-gal. insecticide reservoir is mounted solidly on the frame of the device and moving parts are machined for leakproof action. Oil is distributed evenly over the brushes in the spring-mounted steel arch which accommodates itself to the animal's back.



Portable Concrete Mixer. An oil company welder who needed a small-batch concrete mixer for setting fence posts and equipment bases converted a salvaged auto wheel, a steel drum, and some pieces of angle iron to his purpose. The unit is light enough to be loaded on a truck, and it can be powered by the same truck through a belt that connects the drive pulley and a jacked-up rear wheel.

Better pictures are simpler with the smart, competent KODAK REFLEX camera

black-and-white . . . color . . . flash

—quick, expert composing of subject with extra-bright ground-glass finder . . . shows image details in full picture size

—sharp focusing—"punchy" pictures—with 4-element *f*/3.5 twin lenses . . . both *Lumenized* (ultrahard coated)

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WRATTEN FILTERS use gelatin for "pure color"

Famed for thirty years, *Wratten Filters* use gelatin sheets with pure organic dyes, between two pieces of matched optical glass . . . all sealed into one tight unit with the new cement, butyl-methacrylate.

Advantages: *Colors*—wide variety, each precisely adjusted for its particular purpose. *Sealing*—moisture-resistant, prevents deterioration of filter. *Strength*—metal ring and new cement provide a more rugged unit than a single-glass filter. *Optically flat glass*—especially designed for use with quality lenses. *Cost* is moderate. Consult your nearest Kodak dealer.

Kodak

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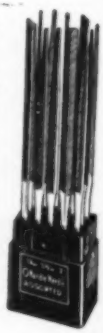
they're back!

...MASTER NEEDLE FILES BY MASTER FILE MAKERS FOR MASTER CRAFTSMEN

WHERE is the craftsman—professional or amateur—who doesn't rate himself entitled to fine tools? Back in full civilian production, Nicholson X.F. (Extra Fine) Swiss Pattern Needle Files are reappearing in hardware and hobby-tool shops everywhere. They're widely regarded as tops in precision files; and they come in the handsome orange-and-black plastic case shown above, with stand-up base holding a dozen assorted shapes. Tiny files like these need precision manufacture to assure best results. Demand *Nicholson* X.F. and get the finest! A popular size for the hobbyist is 5½-inch in No. 2 cut.



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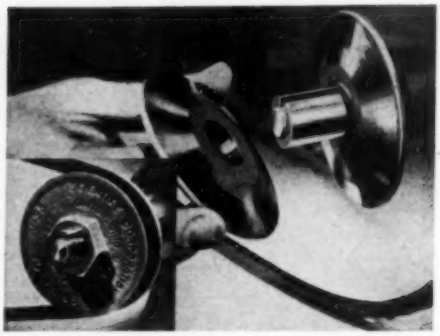
BLACK DIAMOND

NICHOLSON FILES *FOR EVERY PURPOSE*



Pulley Is Adjustable

SEPARABLE halves of a new V-belt pulley, named the Spiralok, may be fixed at any desired spacing, providing an infinite range of variable-pitch adjustment. Spiral wedging action locks the disks in place, without need of keys or setscrews. The pulleys are said to be especially suited for home-workshop use, refrigerators and pumps.

Tripod Needs No Locking

AN IMPROVED tripod head, which dispenses with unlocking to tilt or swing a home-movie camera, has been introduced by the Eastman Kodak Company. Once adjusted to balance the weight of the camera, special clutches with multiple disks of felt and polished metal permit moving it with exceptional smoothness, according to the maker. The camera stays put in any position without locking.

NEW EVEREADY
TRADE-MARK

FLASHLIGHT BATTERIES

*Now last 93% longer!**

Enough Energy to Hurl This Daring Miss Over 100 FEET!

Imagine!—the girl weighs 110 pounds! Yet the total energy in one tiny "Eveready" flashlight cell—properly expended—is equal to the charge that sends her flying up—up—over the gasping audience, to land over 100 feet away.

PACKED with new dynamic power . . . dazzling in performance . . . durable beyond any flashlight cells you've ever known, "Eveready" flashlight batteries give you the year's greatest energy value. That's a 93% *increase* over the great record made by pre-war "Eveready" cells . . . nearly double the life of light. Yet you pay no more.

The registered trade-mark "Eveready" distinguishes products of

NATIONAL CARBON COMPANY, INC.

30 East 42nd Street, New York 17, N. Y.

Unit of Union Carbide UCC *and Carbon Corporation*

High Energy

MEANS BRIGHTER LIGHT, LONGER LIFE

* To you, this means nearly *twice* the energy . . . almost *two times longer life* of bright white light. And it's yours for the pre-war price . . . *still only 10¢!*

Ford's out Front with "Baked-on" beauty

Ever notice how Fords keep their "showroom complexion"? Ford's beauty secret is a three-way treatment . . . with special synthetic hi-gloss resin enamel . . . with a chemical rustproofing over Ford's "Lifeguard" bodies and exposed parts.

- Ford's "baked-on" finish dries evenly, with no "bubbling" or surface tension. Tests show Ford's luster doesn't dim or fog, that it lasts longer with less polishing in tropic sun, salt sea air, or winter ice and snow.
- The tenacious phosphate rustproof coating under the finish keeps Fords safe from rust, chipping, and peeling around scratches and dents. No wonder Fords keep that "showroom complexion."

There's a Ford in your future

Wake up your Horsepower

Your car *wakes up*, with a Casite tune-up. No more sputters, no more jerks—just a smooth surge of power. It's hard to believe that anything could improve performance so quickly, so easily. It's been proved in millions of motors.

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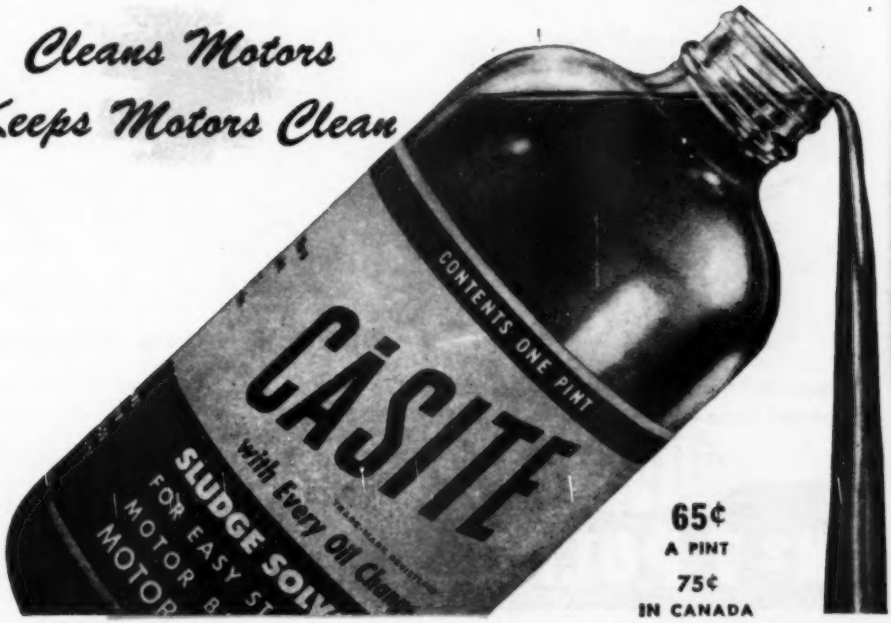
Casite cleans your motor . . . speeds lubrication . . . retards formation of sludge and gum. A pint of Casite through the air intake every three months and a pint in the crankcase every oil change, keeps your car free-running and full of pep.

the Guaranteed Way!

Double-Your-Money-Back if your car doesn't run better and smoother with Casite. And Casite makes this famous guarantee no matter what kind of motor oil you're using. Give it a try. Casite is sold by service stations, garages and car dealers everywhere. The Casite Corporation, Hastings, Michigan, and the Casite Division, Hastings Ltd., Toronto.

Cleans Motors
Keeps Motors Clean



65¢
A PINT
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Big date tonight

But car is grimy

It'll shine up quick

If you just try me

Removes dull traffic film—restores the original color and lustre—quickly, easily and safely.

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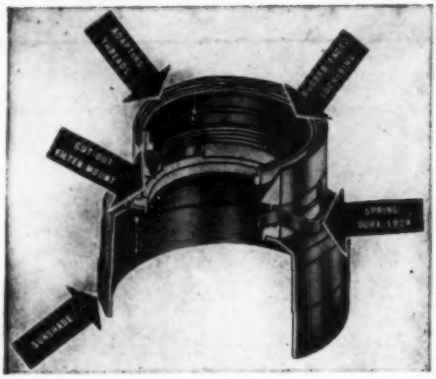

Adjustable Filter Mount

AVAILABLE in five sizes, this filter mount and sunshade fits camera lens barrels ranging from ½ to 2½ inches. A rubber lock ring protects the lens barrel from scratching. The Harrison Adjustable Mount is made of aluminum, duralite and clock-spring steel, and has cutout sides for easy insertion of filters without fingerprint smearing.

Clamps Speed Repairs

BROKEN posts, beams and handles can be easily repaired, and hoses or pipes can be quickly clamped or banded, with the new kit manufactured by the Punch-Lok Co., of Chicago. It consists of flat-strip steel clamps of assorted sizes and a tensioning tool that reaches confined places. Repairs can be made in a few minutes on round, square or oblong items that measure anywhere from ½ to 10 inches in diameter.

Dependable

CHAMPION

AMERICA'S FAVORITE SPARK PLUG

The roaring midgets are in full cry again, dispensing their spine tingling thrills to enormous crowds nightly, on race tracks all over the nation. Tremendous acceleration, and keen driving skill are their stock in trade as they race literally hub to hub. Neither car nor driver can falter for a split second, and that's precisely why dependable spark plugs are of paramount importance. The *overwhelming* majority of midget car pilots use dependable Champion Spark Plugs. Here is testimony by experts that Champions make every engine a better performing, more dependable engine. Champion Spark Plug Company, Toledo 1, Ohio.

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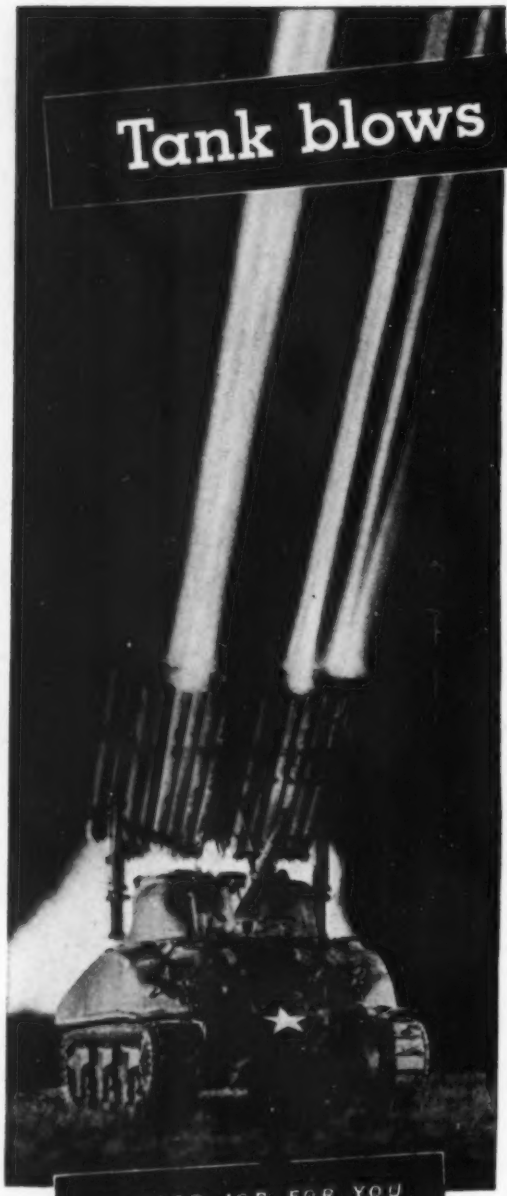
DEMAND NEW DEPENDABLE CHAMPIONS FOR YOUR CAR

Listen to the CHAMPION ROLL CALL . . . Harry Wismer's fast sportscast every Friday night, over the ABC network

Tank blows its top



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"Calliope" is an all-steel model of the enormous strides which the Ground Forces have made in the field of mechanization. At much less danger to itself, one crew can perform missions which would formerly have taken many times the number of men.

Then, too, "Calliope" shows the interesting research and development being carried on by the Army. Any young man with any kind of mechanical bent will find the U. S. Army Ground Forces a fascinating workshop in which to learn skills and trades and give his new-found knowledge the practical application it needs.

There are other advantages, too, to a Ground Forces career. Good pay, steady work, living essentials provided without charge, travel, adventure, and the thrill of doing a worth-while job for our country. Get the facts at your nearest U. S. Army Recruiting Station.

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NEW BELT SANDER FOR DRILL PRESS

Does Finishing Jobs Faster, Better

A new, simple, faster method for many surface finishing jobs on wood, metal, plastic and other materials has been announced by the OK Specialty Company of Chicago. The new finishing method takes the form of the OK Belt Sander, a drill press attachment.

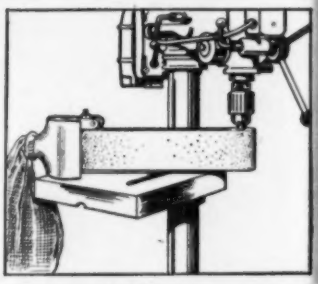
The new sanding device weighs less than 5 pounds. It is made up of an aluminum base with backing plate or platen, a driven pulley mounted on ground steel shaft and running on precision ground ball bearings, and cast aluminum driver pulley mounted on ½" ground steel shaft to fit into the drill press chuck.

The base of the sander is bolted to a drill press table. Merely by moving the drill press table, the attachment can be adjusted to handle sanding belts from 26" to 36" in length.

The sander takes belts from ½" to 3" in width. Two sanding belts, one coarse grit and one fine grit, are furnished with each attachment. The device comes assembled ready for use with any drill press. Most efficient performance is achieved at 3500 to 5000 RPM. The sander stands 5" high, and the base measures 10½" long by 3¼" wide.

Another time-saver on the job is chewing gum. Chewing gum may be used even when hands are busy; and under dust conditions helps to keep the throat moist—prevents "false thirst." For these reasons many plant owners make Wrigley's Spearmint Gum available to everyone.

You can get complete information from OK Specialty Company 4655 N. Clark St., Chicago, Ill.



OK Belt Sander Assembled, Ready for Action

AB-73

AC
FUEL
PUMPS

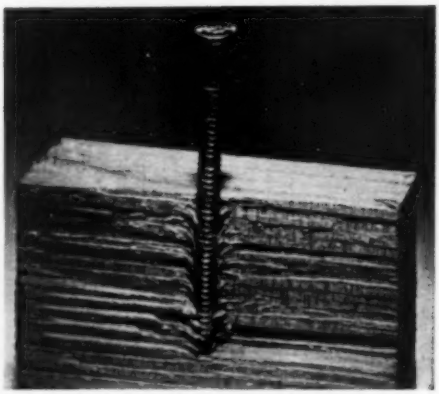
Pulsing steadily, hundreds of times a mile, your AC Fuel Pump is the strong, reliable heart of your fuel system. It has given you long, faithful service because of its inbuilt quality and scientific design.

You can prolong that faithful service indefinitely, if you insist upon an AC when you replace your present pump with a new or rebuilt one.

AC SPARK PLUG DIVISION • GENERAL MOTORS CORPORATION

Tubes Dress Up Lights

ATTRACTIVE lighting effects for restaurants, hotels and stores can be achieved by slipping colored Tenite tubing over fluorescent lamps. Light is diffused by longitudinal prisms on the tubing's inner wall. Because the tubing is transparent, little light is lost in transmission, and glare is said to be reduced by 50 percent. Spacer splines hold the device on the lamp. Made by Extruded Plastics, Inc., of Norwalk, Conn., the tubing is shatterproof and comes in seven colors. It requires no special fixtures.



Nail Grips Like a Screw

WOOD fibers wedge themselves tightly into the ring-shaped grooves in this nail, which can also be driven through sheet metal. Made by the Independent Nail and Packing Co., of Bridgewater, Mass., the nails come in a variety of rustproof metals.

All you want in Modern Heating!

Perfection stands at the top in providing all the things you want in oil heating comfort. Since 1888, the highest standards of engineering and workmanship have produced dependable heaters for American homes . . . for *your* better living.

Enjoy the clean, comfortable warmth of Modern PERFECTION Oil Heat!

Uniform Heat—quick radiating and circulating warmth always there, day or night, when and where you want it.

Automatic Control—you can have fully automatic operation with an outside fuel supply tank and Accessory No. 12.

Clean Burning—soot-free, smoke-free, odor-free, result of advanced Perfection engineering over the years.

Blower—addition of Blower No. 24 will carry heat to far corners and other rooms.

Quiet Operation—a silent servant producing the quick, clean comfort of better living.

and—no coal to carry, no fires to build, no ashes to empty, no soot-streaked walls to clean!

Ivanhoe Model 2205 Space Heater, other sizes available

PERFECTION

The World's Largest Manufacturers of Oil Burning Appliances for the Home

PERFECTION STOVE COMPANY, 7898-A PLATT AVE., CLEVELAND 4, OHIO

Firelight Portable Model 750 for "spot" heating anywhere

USE VESTPOK ANY TIME **and any place to whisk away "between-shaves" stubble. Small as a match folder, this scientifically designed, precision instrument supplements, but does not replace, a man's regular razor. Can't cut, scrape, nick or burn. $3.00 with 10 blades of the finest razor steel. At your favorite store or write to us direct: Vestpok Division, Ward Machine Co., Inc., Dept. S-9, Brockton 64, Massachusetts.**

Needs no soap, water, brush, mirror or electricity

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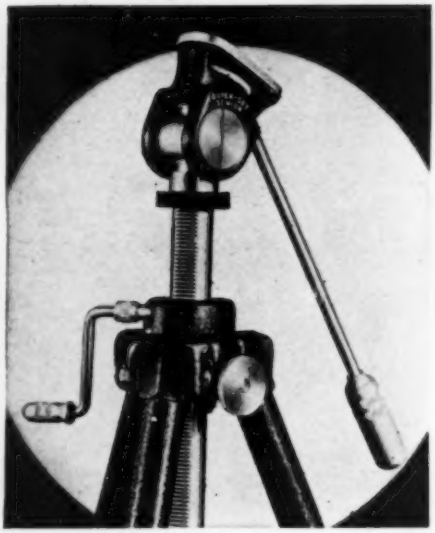
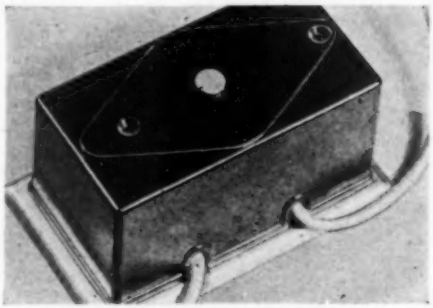


Tripod Has an Elevator

HERE's a tripod on which you can adjust the height of the camera without fiddling with the tripod legs. The secret is a central column that can be raised or lowered with a fold-away crank handle. A nonslip, set-screw brake locks it into place. Called the Quick-Set Elevator Tripod, the device has a maximum elevation of from 15 to 17 inches, according to the model. It is made by Quick-Set, Inc., of Chicago.

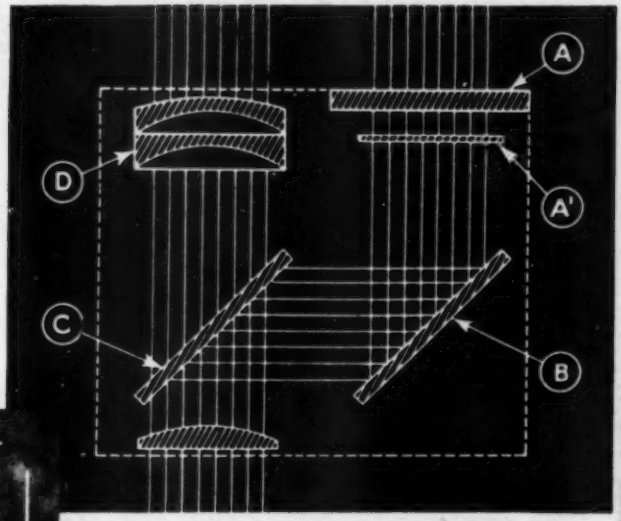


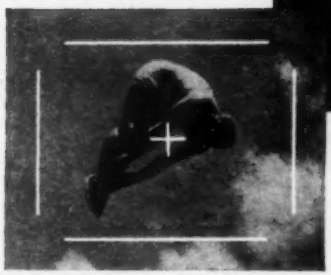
Guard Shields Outlets

PARENTS of small children may be interested in the Save-A-Shock electric outlet guard. It fits over a wall outlet so that nothing can be pushed into it nor the plug pulled out. The plastic guard can be installed in less than a minute.

argus 21 *Markfinder*

does it with Mirrors..





The cross-section above shows the "Markfinder" principle. Light passing through ground glass (A) and the reticle (A') is reflected by mirrors (B) and (C) and is projected into the field of view through distortionless doublet finder objective (D). You see the picture area outlined with a white line... always the same whatever your eye position.

Only Argus 21 has "Markfinder"—Photography's newest camera sight incorporating war-born gunsight secrets.

"Markfinder" consists of one doublet lens, one single lens and two mirrors. It shows you a center cross-mark and a guideline frame projected *right on your subject*. You can't miss!

Aiming with "Markfinder" is quicker. Following action is smoother—more accurate. *And*—you always get exactly what you see. That means ever-improved composition, a critical factor when you use color.

For a real photo treat, ask your dealer to show you Argus 21 with "Markfinder" today. You'll admit there's never been anything like it for speed, simplicity, accuracy.

ARGUS, INCORPORATED • ANN ARBOR, MICH.

Added Argus Features

- F 3.5 Anastigmat, coated lens corrected for exceptionally true color.
- Double exposure guard.
- Accurate shutter speeds from 1/10 to 1/200.
- New, built-in flash synchronization.
- Removable lens for use on enlarger
- Automatic film stop... PLUS—new, exclusive "Markfinder".

Why Wait?

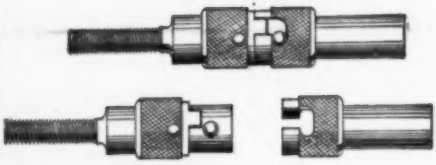
QUALITY TOOLS ARE A GOOD BUY NOW

One of Plomb's popular ½" Drive Socket Sets for efficient nut turning.

Great volume enables Plomb to give you higher quality tools—at prices close to pre-war levels. That's why it will pay you to buy the tools you need *now*—to make your set complete and up-to-date. Get them from your Plomb dealer today. Write for catalog to Plomb Tool Company, 2257H Santa Fe Avenue, Los Angeles 54, California.

4785

PLOMB
streamlined
TOOLS



Quick Disconnect Unit

THESE little gadgets speed the installation and removal of aircraft engines. Called Purdy Quick Disconnects, they replace clevis pins, bolts, nuts and locking wire. A slight twist opens or closes the locking collar. Distributed by Durham Aircraft Service, they have CAA acceptance for use on civilian planes.

Portable Oscilloscope

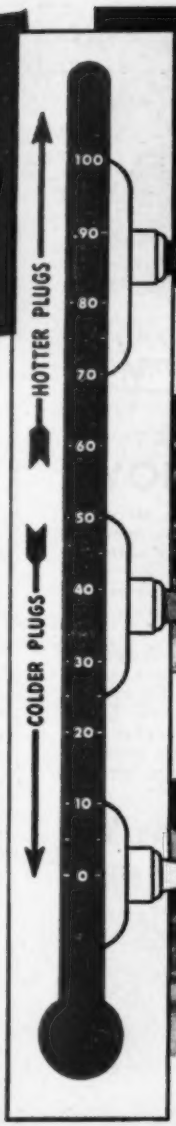
RCA's new portable oscilloscope is said to be the first three-inch type to meet laboratory accuracy requirements. Incorporating many advantages of expensive research instruments, it is designed for detailed observation and accurate measurement of the extremely short, sharp-fronted pulses produced by television circuits, ignition systems, pulse generators and the like. The unit shown, model WO-79A, weighs 42 lb.

AUTO-LITE Plugs

Have you ever checked the Heat Range of your Spark Plugs?

THE HEAT range of a spark plug can be varied through such design factors as length of firing tip, insulator material, volume distribution in the firing end of the plug and material used in electrodes. Make sure your spark plugs are of the correct heat range for your engine. Auto-Lite spark plugs operate for any throttle range and load. Spark Plugs of correct heat range and a "Plug-Chek" at regular intervals using the Auto-Lite "Plug-Chek" Kit, will help stop power loss, gas waste and spark plug trouble.

Mail the coupon today for the Auto-Lite "Plug-Chek" Kit which quickly helps you find spark plugs that are causing trouble or are of incorrect heat range. All you do is match plugs with pictures on the "Plug-Chek" Indicator—each example refers to a page in the "Plug-Chek" Data Book that shows you what needs to be done.



STOP-AND-CREEP DRIVING—Police cars, hearses, door-to-door delivery vehicles, etc. that have long periods of idling usually require a hot plug to prevent fouling.

AVERAGE DRIVING—The plug normally specified is of the proper heat range to handle all requirements under average driving conditions where the car is in reasonably good condition.

CONSTANT HIGH SPEED—Cars required to operate for long periods at high speed usually use colder plugs than normally specified, for best results.

Send for Auto-Lite "Plug-Chek" kit...only 10¢!

THE ELECTRIC AUTO-LITE COMPANY, Department PS4, Toledo 1, Ohio

Enclosed find ten cents for the Auto-Lite "Plug-Chek" Kit that includes both the "Plug-Chek" Indicator and Data Book.

Name_____

Address_____

City_____

AUTO-LITE

Ta-pat-co Brings You

New Outdoor Comfort

IT TOOK
TA-PAT-CO
"KNOW-HOW"

—to bring you this handsome, all wool, full-cut sports shirt with roomy man-size pockets. The soft, comfortable collar is worn open or snugged down. See it in your favorite color at your sporting goods store — you'll agree it's every inch a man's shirt.

It took Ta-pat-co *know-how* to design this hunting coat, with full width game pocket, and quick easy access for removing game, cleaning and airing the blood proofed lining. Pockets galore—flap-protected shell loops—special water proofing across shoulders, cut bi-swing for freedom of action.

New Ta-pat-co Game Bag

—one big pocket across the back holds your limit — two roomy flap covered side pockets hold shells, lunch, etc. Wide comfortable adjustable shoulder straps evenly distribute the weight. Snap fasteners on back pocket and in front hold the bulk down, make it fit snugly. Tough and snag resistant—it slips easily through the brush. You can't beat it for field shooting or hiking. See it at your dealers.

DON'T MISS IT—GET YOUR COPY OF THIS BOOK

How to call ducks without a call . . . how to kill a rabbit without a gun . . . how to boil water in a wooden bucket . . . get the answers to these and hundreds of other questions that make outdoor sports more pleasant and successful. Printing limited—be sure to get your copy—send 10c in coin or stamps now to—

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"STATION WAGON"
DOUBLES YOUR BIKE'S USEFULNESS

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SPECIFICATIONS—Rated over 200 pounds capacity. Strong steel undercarriage, natural finish wood "station wagon" sides. Semi-pneumatic 10-in. tires. 24" long, 18" wide, 20" deep.

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CHICAGO

on your shaper with our high speed steel—pattern ground — shaper knives $1\frac{1}{8}$", $1\frac{3}{8}$", and $1\frac{3}{4}$" for O. G. Cove and bead doors. 4 knives: 2 coping and 2 sticking, priced at $19.44. $2\frac{1}{4}$" over all length. Prompt shipments—also other knives. Send 10c for Catalog.

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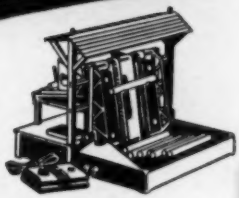
Rebco Corporation, 204 E. 44th Street, New York 17, N. Y.

See and Hear



LIONEL TRAINS in Action

This year not alone do we offer you the 32-page full color catalog, but we have provided a Sound Effects Record as well so you can HEAR LIONEL Trains whistle, and thrill to the excitement of LIONEL model railroading. The new LIONELs are simply out of this world. See them! Hear them!

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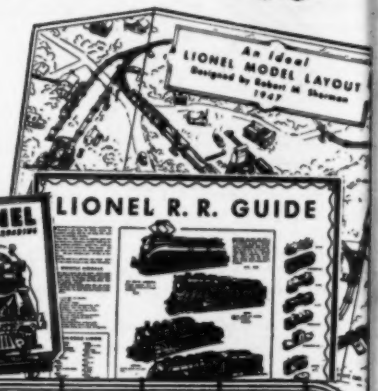

SEE THEM—

HEAR THEM—

Not alone can you see the LIONEL Trains in the catalog, but you can HEAR them in action on the 4-inch record.

LIONEL

LIONEL TRAINS
Box No. 419, Madison Square Station, New York 10, N. Y.

Please send me offer checked below. Complete special offer of Catalog, Sound Effects Record, Fun Book, Wall Chart, and Ideal Layout—all for 25c.

☐ I enclose 25c for Special Offer. ☐ I enclose 10c for catalog only.

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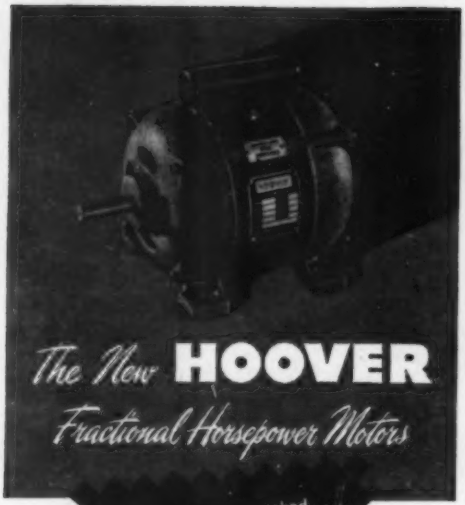

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Fractional Horsepower Motors

Compact, power-packed watch-like precision, work-horse stamina. Made by the manufacturers of the world-famous Hoover Cleaner.

The Hoover name on the new Hoover Motors is your assurance of the finest in fractional horsepower motors.

The new Hoover Motors are designed with the same electrical engineering skill and know-how that have produced more than 6 million Hoover Cleaners.

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Induction run . . . single phase . . . 60 cycles . . . 1725 R.P.M. . . . heavy duty . . . built for continuous operation.

Capacitor start . . . more than 300% full load starting torque with minimum current flow.

No vibration or "shift" . . . integral feet, carefully machined to give solid mounting and quiet operation.

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Laminated steel rotor . . . carefully ground and balanced for maximum efficiency.

Centrifugal starting switch . . . built for trouble-free operation.

High-grade ball bearings . . . sealed against dust and grit, give smooth performance and long wear.

Rotation . . . clock or counterclockwise.

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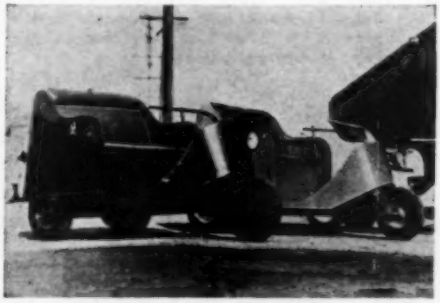
Hobby shops *Garage tools*

THE HOOVER COMPANY

Electric Motor Division, North Canton, Ohio

"Squeeze" Bottle Opener

DEPARTING from the "pry" principle of getting caps off bottles, the Eagle Lock Co., of Chicago, has devised an opener that fits down over a cap and levers it off when pressure is applied to upright handles. The opener grips the cap until shaken free.



Laminated-Plastic Body

A ONE-PIECE body section of laminated plastic has recently replaced the original all-steel frame of the "Autoette," an electric runabout used in industrial plants during the war and later converted for personal use. The body, constructed of Fiberglas and Laminac resin, is molded into its curved shape over an inexpensive form.

You change blades in a flash with the modern

Gillette

ONE-PIECE RAZOR

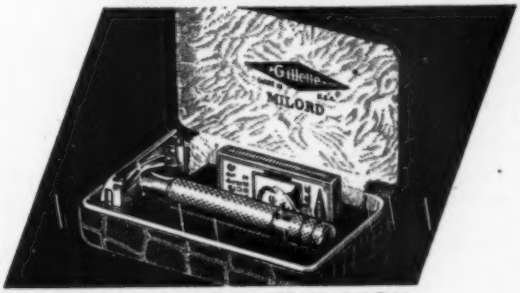
SHAVING is mighty quick and easy when you use a modern Gillette One-Piece Razor. There's nothing to take apart or put together. You change blades in jig time. Twist . . . the razor opens. Twist again . . . your blade's locked in position. For cleaning both razor and blade just loosen the holder, rinse and shake.

Enjoy utmost shaving comfort and convenience. Get a superb Gillette Aristocrat or Gillette Milord One-Piece Razor. They're the finest shaving instruments money can buy!

Gillette Safety Razor Co.
Boston 6, Mass.

Gillette Aristocrat One-Piece Razor, gold plated, with case and ten Gillette Blue Blades $3.79

Twist...It's Open



Gillette Milord One-Piece Razor, gold plated, with case and five Gillette Blue Blades $2.50

Twist...It's Closed

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look SHARP! **feel** SHARP! **be** SHARP! **use Gillette Blue Blades** WITH THE SHARPEST EDGES EVER HONED

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Vibro-Tool complete with 22 attachments in handsome, polished wood chest.....$16.50

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With a No. 209 Drill Stand, the 89 Drill makes a capable lever operated drill press. Order from your local Speedway dealer.

No. 117 Grinder $14.95

No. 229 Drill Stand (Less Drill) **$5.25**

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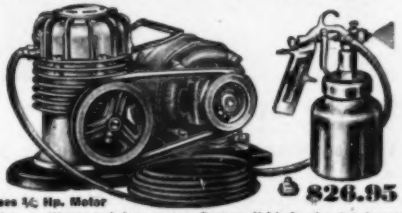
Chrome Plated -- Fits All Cars

Postage Free on Money Order, Check or Cash

PAT. PEND. LYONS PRODUCTS Co. 2319 Ridgeley Dr. Los Angeles 16, Cal.

Portable Paint Sprayers



Uses ¾ Hp. Motor

$26.95

Complete as illustrated, less motor. Sprays all kinds of paint, lacquer, varnish, etc.....Oil-less ball bearing compressor, 2 cu. ft. air per minute, 15 to 50# pressure. Sprays paint 5 times faster than hand brushing.

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Just trace the pattern on the wood, saw it out and glue it together. There are 94 projects for furniture, toys, gifts, buildings, home needs.

And the designers of Easi-Bild Patterns recommend CASCOPHEN Resorcin Resin Glue for assembly of all outdoor projects. CASCOPHEN makes permanent waterproof, heatproof, moldproof bonds. The *only* completely durable glue for home use!

Prove it yourself. See how easy it is to make better projects this new way. Start with the "Project of the Month," No. 32 Lawn Chair, shown above. Mail this coupon now!

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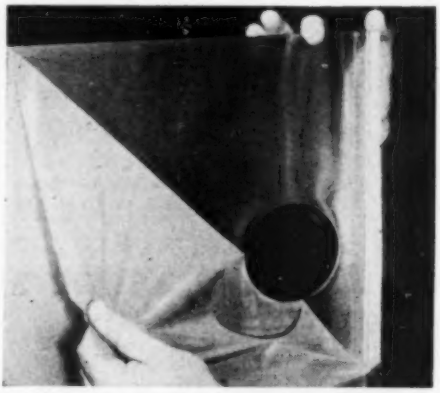
Lever Locks Vise

KNEE action closes and locks a lever-type vise, leaving hands free for adjusting material. Produced by P. A. Fleury & Sons, of Baltimore, Md., the vise is capable of holding stock up to 10 inches.



Plastic Guards Metals

A STRIPPABLE, plastic coating—the kind used during the war to protect machinery during shipment overseas—is helping metal industries to prevent corrosion. Brushed or sprayed on a surface, the coating dries quickly to a rubbery film that peels off easily. Developed by Eronel Industries, of Los Angeles, Calif., the protective finish resists abrasion, alkalies, acids and all atmospheric temperatures.

Now you can equip for the most productive winter you've ever had in your shop! Atlas drill presses are again available at your distributors — at prices near pre-war levels!

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Here are some of the operations you can handle easily and quickly with any Atlas drill press and its low cost accessories: precision drilling, tapping, reaming, and routing in metal and plastics; mortise and tenon joints for tables, chairs, doors, bookcases, cabinets, storm windows, screens; inlaying carving, dovetailing, shaping, and drum sanding — *all important additions to the practical "capacity" of any shop.*

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From its finely balanced pulleys to its solid base an Atlas drill press is built to give you rigidity, smoothness, and life-time accuracy. Head, column, table and base are extra heavy. Precision-ground table tilts 90° right or left. The exclusive Atlas "floating-drive" spindle design — with deep-grooved ball bearings — keeps the precision-ground spindle accurately aligned for smooth operation. Ask your Atlas distributor to show you the bench and floor types in his display room, or send for latest literature. Atlas Press Co., 955 N. Pitcher St., Kalamazoo 13D, Mich.

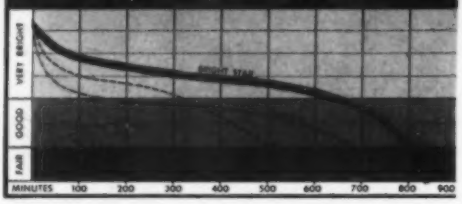
* Prices, less motor, F.O.B. Kalamazoo.

Now! tests prove-

BRIGHT STAR BATTERIES

give more bright light longer

Here is your proof!



These results of vital service tests* prove that Bright Star batteries give you more *bright light* longer than two other leading brands tested. Insist on the best—it's Bright Star by test!

**Chart based on laboratory tests conducted in accordance with government standards.*

Ask for popular Bright Star model batteries.

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Fill Holes, cracks, dents, gouges

These BETTER FILLERS

- HARDEN FASTER
- SHRINK LESS
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FILLS HOLES IN ONLY 1 APPLICATION

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Only 25c for large tube of Wood Dough and interesting booklet. Write

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DURATITE

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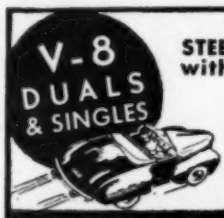

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SINGLES, Chev, V-8, Plymouth, Steels $5.50, Aluminum $6.50. Chry., Olds., Buicks, etc., Steels $7.50, Aluminum $8.50. V-8 and MERCURY DUALS, Steel $17.50, Aluminum $20.00. Aluminums are guaranteed for life of your car.

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Ten-ton press, ideal for all kinds of pressing, separating, straightening, and bending jobs. Ample capacity for home shops. Easily adjustable table takes work up to 18 inches wide and 11½ inches high. Roller-bearing ram for long life. Send for free bulletin showing press and wide variety of accessories.

UT-10A Press f.o.b. factory $28.25

DAKE ENGINE COMPANY
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. . . in your own woodworking shop — with Delta-made

Homecraft® Power Tools

A whole new world of fun and healthful relaxation opens up when you follow this fascinating hobby. And now your dealer has popular-priced Homecraft Power Tools that bring this happiness within easy reach.

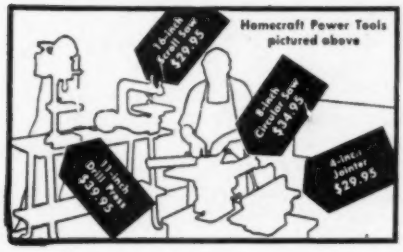
Homecraft tools are a product of Delta—maker of Delta Power Tools and Delta Machine Tools, long famous for safety, accuracy, and dependability in schools, factories, and home shops.

Made expressly for the hobbyist, Homecraft Power Tools take the work out of woodworking. They make it possible — even for the beginner — to turn out attractive, useful projects and do it quickly and easily. With these sturdy tools in your shop, you can make toys, small pieces of furniture, and many other things you're proud to use and share. Fun for the whole family.

Visit your Homecraft dealer now. He'll be glad to advise you on starting or improving your shop. Inspect the tools he has on display, and notice how much you get for your money when you buy Homecraft Power Tools. Do it today.

HOMECRAFT® POWER TOOLS

General Sales Office — Chicago 2, Illinois



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Big 32-page catalog shows all Homecraft Power Tools and accessories. Send 10¢ in coin or stamps to cover mailing and handling. "Happiness Herald," illustrated guide to woodworking, sent free.

HM-91A

Tear out coupon and mail today

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Rockwell Manufacturing Company
682K E. Vienna Ave., Milwaukee 1, Wis.

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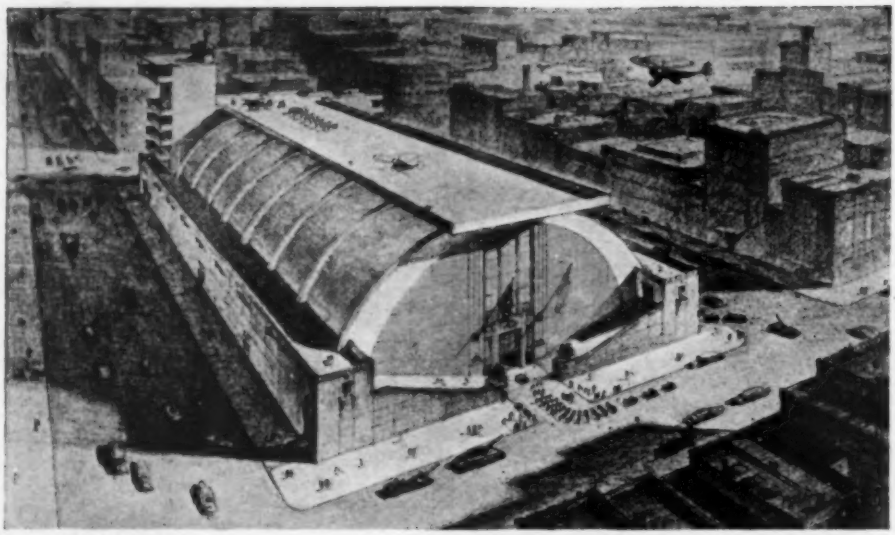
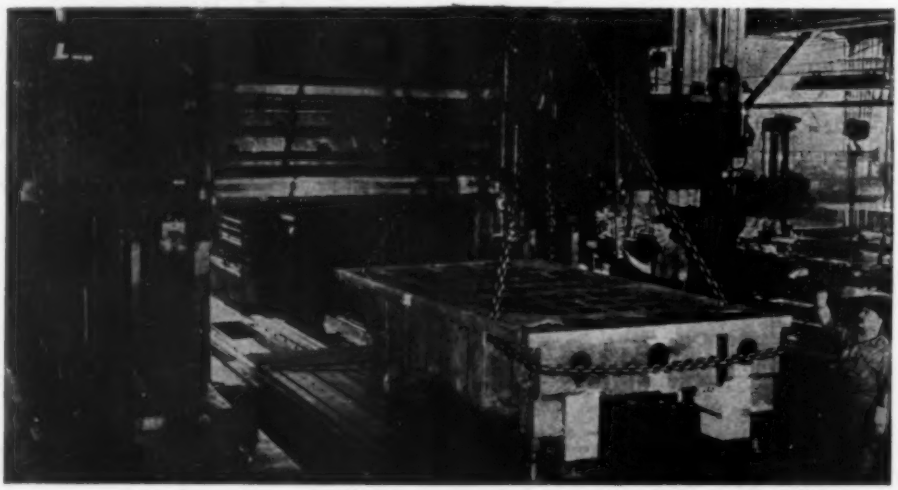


Armory for the Air Age

WITH a huge roof to permit helicopter operations and a thick concrete drill floor covering an underground base for troops and equipment, the building pictured above has been proposed as a model for National Guard armories. Designed by James C. Mackenzie, New York architect, to meet modern military needs, the massive, air-conditioned structure would also serve as an air-raid shelter—or, in peacetime, a community center.



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WAITING for a new car? This gigantic machine, believed the largest of its kind in the auto industry, may help you to get one quicker. A two-head milling machine, it weighs 370,000 lb., has a 38-foot bed and an 18-foot table, and requires 178 hp. for its operation. Five flatcars were used to carry it to Detroit for installation at the die and machine plant of the Fisher Body Division of General Motors, and 300 cubic feet of cement went into its foundations. Here it is pictured just as a tremendous die for forming automobile parts is lowered into position on the machine bed.

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No wonder motorcycling is the favorite sport of so many fun-loving, vigorous, red-blooded young men and women! There's a thrill to riding a new 1947 Harley-Davidson that beats anything else on wheels. Owners have grand times — they belong to clubs—make new friends — compete in endurance runs, race meets and hillclimbs. They get out on the open road and tour the country — even tour other lands. Don't merely *wish* for good times — when you can roll up so many pleasure-filled miles on your own Harley-Davidson! Get set for the happiest evenings, weekends and vacations of your life — see your Harley-Davidson dealer NOW — and mail the coupon today.

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BARREL—"Hi-Pressure" smokeless steel, length 21".
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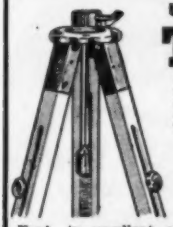

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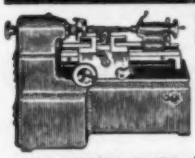

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Complete with Cord 3 Blades

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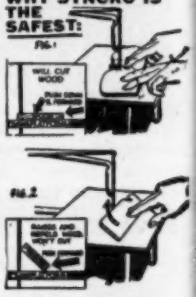

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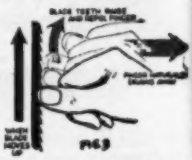

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60-lb. Coal Cap.

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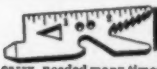

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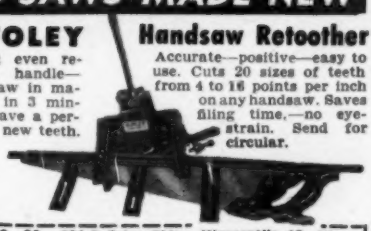

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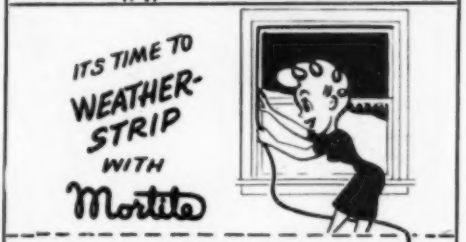

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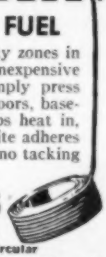

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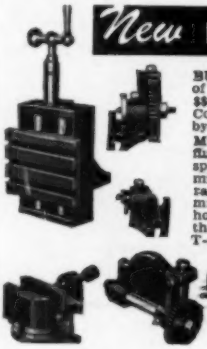

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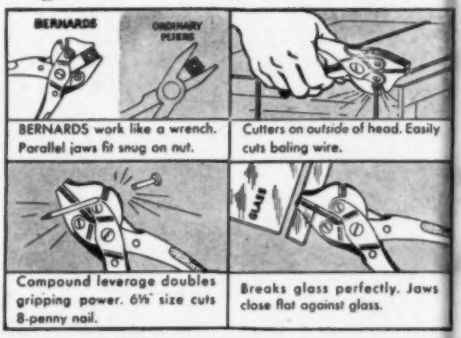

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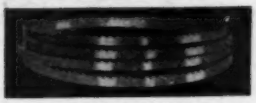

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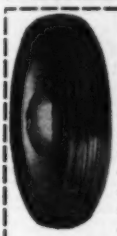

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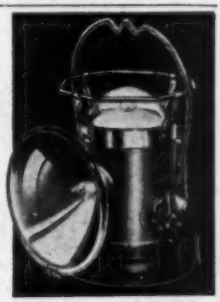

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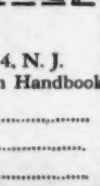

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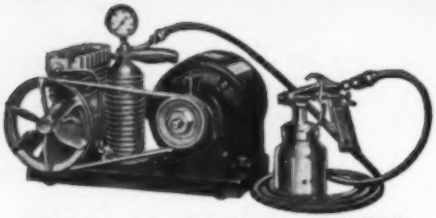

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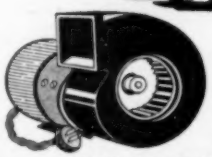

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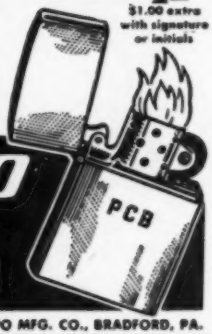

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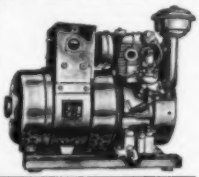

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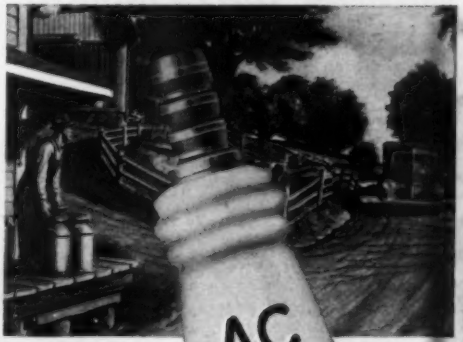

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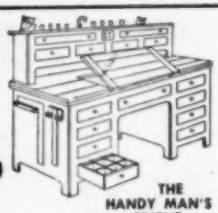

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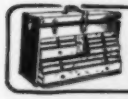

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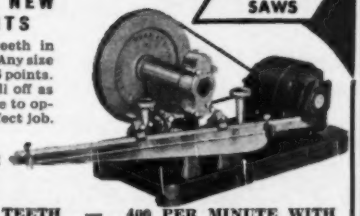

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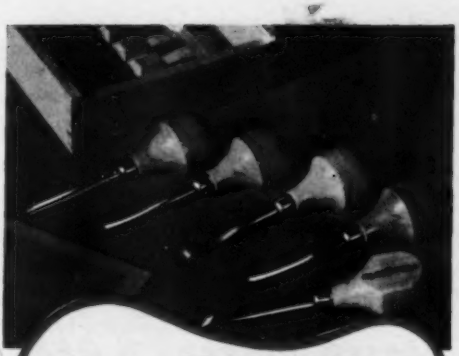

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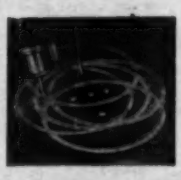

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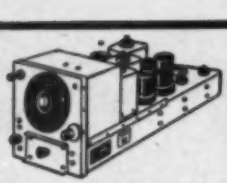

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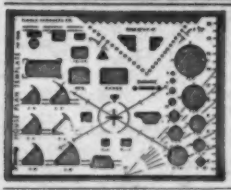

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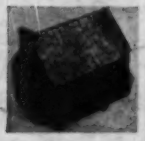

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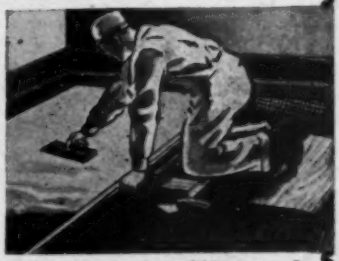

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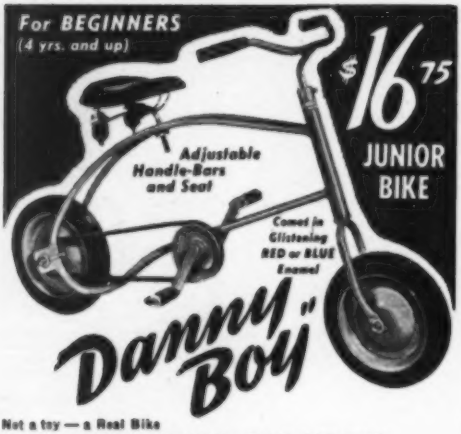

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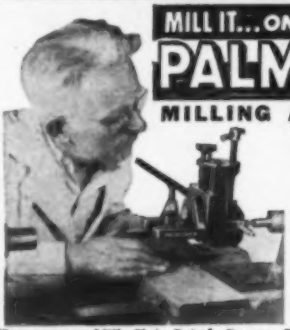

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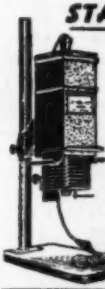

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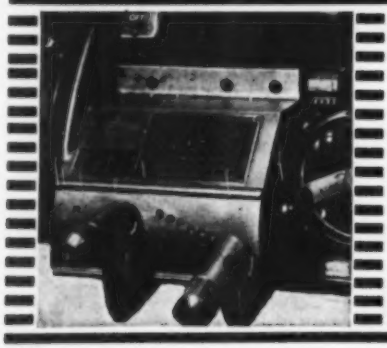

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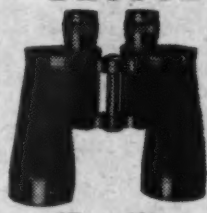

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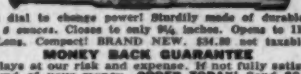

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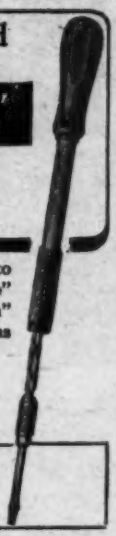

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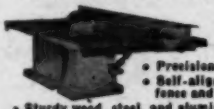

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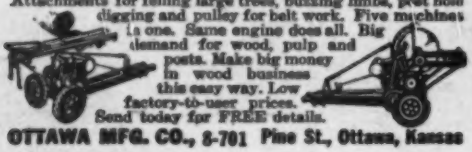

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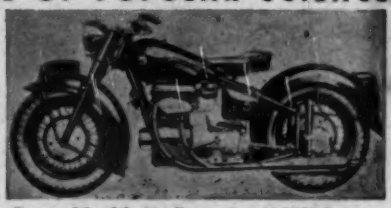

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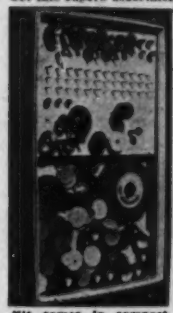

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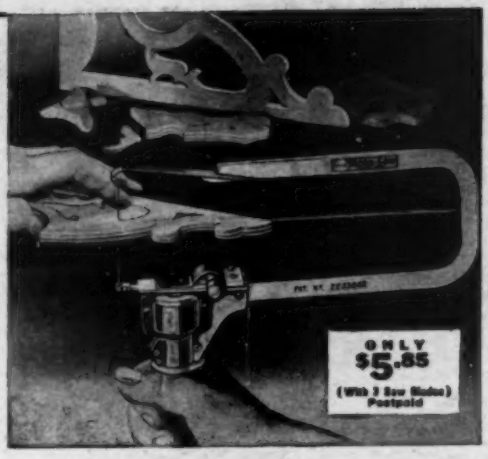

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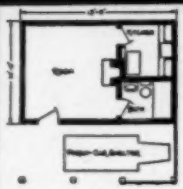

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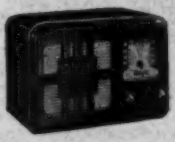

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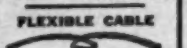

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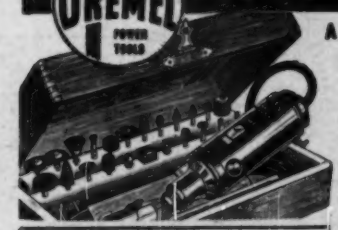

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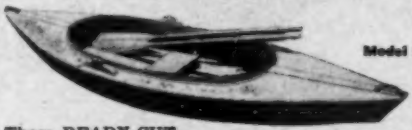

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TO: Reader
FROM: Editor

It-Might-Come-In-Handy Dept.

EVERY PSM editor has an active curiosity. But there are certain local characters around the shop who are as likely to have a screwdriver as a pencil in their shirt pockets. Referred to without prejudice as the "dirty-hands" editors, they are principally concerned with the back of the book—those pages devoted to automobiles (and the imperishable Gus Wilson) and to the countless gadgets and projects published each month.

A dirty-hands editor is a strange fellow, with values all his own. For him, curiosity has no decent bounds. He has an uncontrollable passion to take the covers off things, to poke and pry behind the panel or cabinet, to admire the shiny little thingummies within, to see how every new device he finds actually works. If on inspection of the innards of a new machine he comes upon a clever cam or a tricky gear train, his delight knows no limit.

Among the other blessings for which PSM's boys in the back room are grateful, the fact that they work in New York City looms large. For New York is one of the world's richest hunting grounds for the bits and pieces so dear to the heart of a dirty-hands editor. With whole blocks of stores devoted to metals, machine tools, motors, cabinet woods, and the like, rare is the week when some staff man doesn't sacrifice a lunch hour to poke happily over the counters and bins in search of that elusive 25B8 tube or 11-mm. O.D. bearing. These easily available riches make him especially sympathetic to the plight of fellow craftsmen in, say, Gap Gulch, Wyoming, who are mainly dependent on the slender resources of a general store. It is for this reason that no workshop project is published until the general availability of materials, in either local outlets or national mail-order houses, has been considered.

The magpie instincts of an editor confronted with an array of hard goods are usually manifested in one of two ways. Home and Workshop Editor Walton heads one group that might be called the Purposeful-Buyer School: He carries little lists containing such notations as "3/16-inch end mill, ½-inch drill rod, 18-gauge copper, 5-amp. fuses." When he returns to his office after lunch, the list is missing but his pockets have a perceptible sag, and he clanks as he walks.

The desk of a dirty-hands editor.

The other group, known as the It-Might-Come-In-Handy-Someday School, is made up of those who return to their desks laden with gleaming bombsight components, surplus gun-director subassemblies and other entrancing bits of treasure. Questioned about what he will do with his purchases, such an editor will generally concede that his plans are vague. "What else could I do?" he will inquire defiantly. "Why, the ball bearings alone are worth more than it cost me."

Frank Rowsome Jr.

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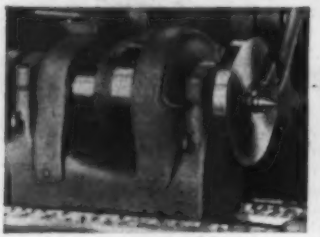

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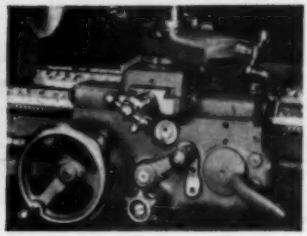

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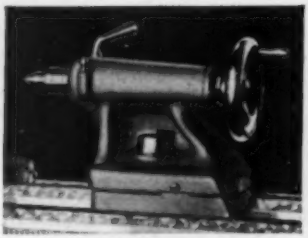

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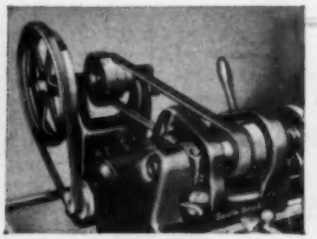

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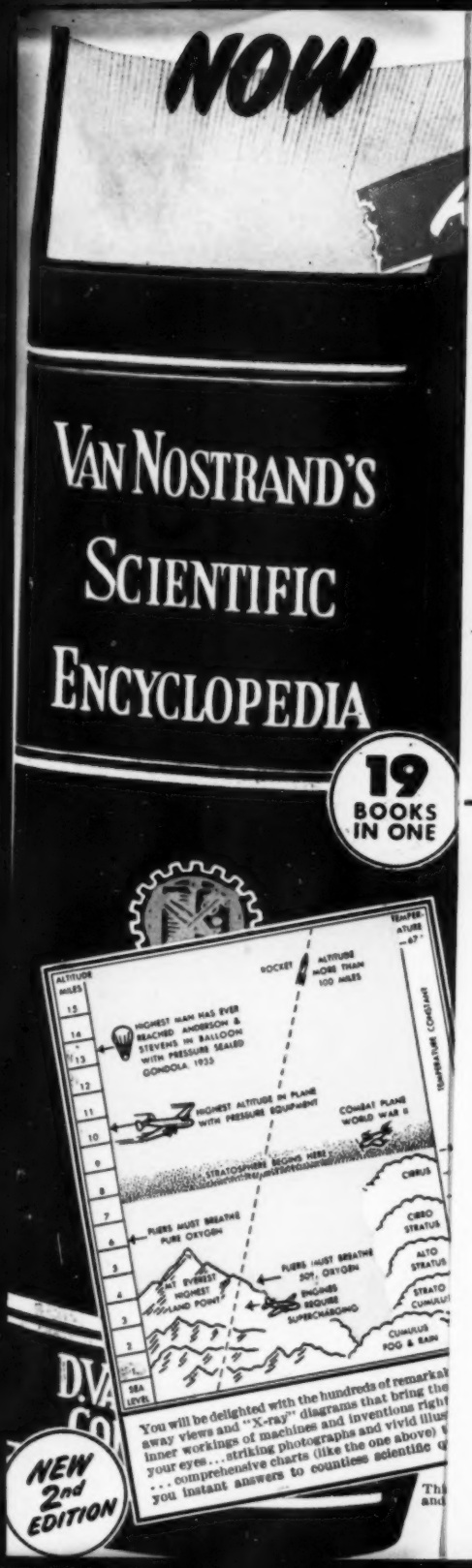

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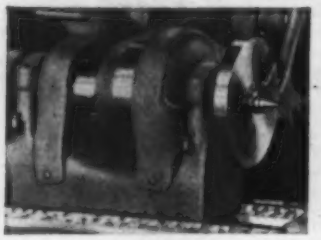

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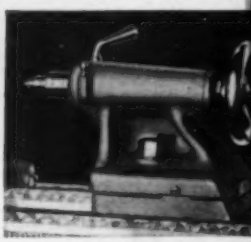

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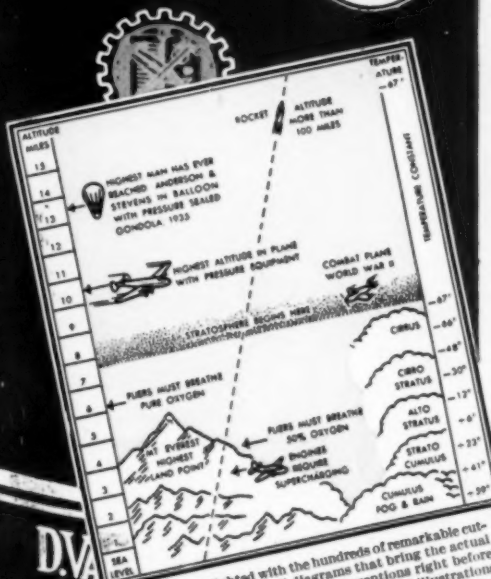

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